CHAPTER 3
AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

This chapter describes the affected environments at Idaho National Laboratory (INL) in Idaho, Los Alamos National Laboratory (LANL) in New Mexico, and Oak Ridge National Laboratory (ORNL) in Tennessee as they appear today. This information provides the context for understanding the environmental consequences and also serves as a reference from which environmental changes brought about by the actions proposed for implementation under both the No Action and the action alternatives in this environmental impact statement (EIS) can be evaluated. The affected environments at INL, LANL, and ORNL are described for the following areas: land resources, site infrastructure, geology and soils, water resources, air quality and noise, ecological resources, cultural resources, socioeconomics, human health risk, environmental justice, waste management and pollution prevention, and environmental restoration.

3.1 Introduction

In accordance with the Council on Environmental Quality, National Environmental Policy Act (NEPA) implementing regulations (40 *Code of Federal Regulations* [CFR] 1500 through 1508) for preparing an EIS, the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." The affected environment descriptions presented in this chapter provide the context for understanding the environmental consequences described in Chapter 4 of this EIS. They serve as a reference from which any environmental changes brought about by implementing the Proposed Action and alternatives can be evaluated; the reference conditions are the currently existing conditions.

For this *Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)*, the candidate sites are INL, LANL, and ORNL (located within the boundaries of the Oak Ridge Reservation [ORR]). For each U.S. Department of Energy (DOE) site, each resource area is described, first for the overall DOE site as a whole, and then for the specific location(s) within the site that may be particularly affected by the Proposed Action and alternatives. The level of detail varies depending on the potential for impacts resulting from each alternative.

The following site-specific and recent project-specific documents were important sources of information in describing the existing environment at each of the candidate sites. Numerous other sources of site- and resource-related data were also used in the preparation of this chapter and are cited as appropriate.

- *Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico (LANL SWEIS)*, DOE/EIS-0238 (DOE 1999a)

- *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (NI PEIS)*, DOE/EIS-0310 (DOE 2000f)

- *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)*, DOE/EIS-0319 (DOE 2002d)

- *Finding of No Significant Impact and Final Environmental Assessment for the Future Location of the Heat Source/Radioisotope Power System Assembly and Test Operations Currently Located at the Mound Site*, DOE/EA-1438 (DOE 2002c)

- *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement*, DOE/EIS-0287 (DOE 2002e)

DOE evaluated the environmental impacts of the Proposed Action within defined regions of influence at each of the candidate sites and along potential transportation routes. The regions of influence are specific to the type of effect evaluated and encompass geographic areas within which any significant impact would be expected to occur. For example, human health risks to the general public from exposure to airborne contaminant emissions were assessed for an area within an 80-kilometer (50-mile) radius of the proposed facilities. The human health risks of shipping materials between sites were evaluated for populations living along roadways linking the DOE sites. Economic effects such as job and income changes were evaluated within a socioeconomic region of influence that includes the county in which the site is located and nearby counties in which substantial portions of the site's workforce reside. Brief descriptions of the regions of influence are given in **Table 3–1**. More detailed descriptions of the regions of influence and the methods used to evaluate impacts are presented in Appendix B of this EIS.

Table 3–1 General Regions of Influence for the Affected Environment

Environmental Resources	*Region of Influence*
Land resources	The site and the areas immediately adjacent to the site
Site infrastructure	The site
Geology and soils	Geologic and soil resources within the site and nearby offsite areas
Water resources	Onsite and adjacent surface water bodies and groundwater
Air quality	The site and nearby offsite areas within local air quality control regions where significant air quality impacts could occur and Class I areas within 100 kilometers (62 miles)
Noise	The site, nearby offsite areas, access routes to the sites, and transportation corridors
Ecological resources	The site and adjacent areas
Cultural resources	The area within the site and adjacent to the site boundary
Socioeconomics	The counties where approximately 90 percent of site employees reside
Human health risk	The site, offsite areas within 80 kilometers (50 miles) of the site, and the transportation corridors between the sites where worker and general population radiation, radionuclide, and hazardous chemical exposures could occur
Environmental justice	The minority and low-income populations within 80 kilometers (50 miles) of the site and along transportation corridors between the sites
Waste management and pollution prevention	The site
Environmental restoration	The site

Note: For the purpose of describing the affected environment, the term site is used to refer to INL, LANL, and ORNL.

At each of the candidate sites, existing conditions for each environmental resource area were determined for ongoing operations from information provided in previous environmental studies, relevant laws and regulations, and other reports and databases. More detailed information on the affected environment at the candidate sites can be found in annual site environmental reports and site NEPA documents.

3.2 Idaho National Laboratory

INL is located on approximately 230,700 hectares (570,000 acres) in southeastern Idaho, and is 55 kilometers (34 miles) west of Idaho Falls, 61 kilometers (38 miles) northwest of Blackfoot, and 35 kilometers (22 miles) east of Arco (see **Figure 3–1**). INL is owned by the Federal Government and administered, managed, and controlled by DOE. It is primarily located within Butte County, but portions of the site are also in Bingham, Jefferson, Bonneville, and Clark Counties. The site is roughly equidistant from Salt Lake City, Utah, and Boise, Idaho (DOE 2000f).

There are 450 buildings and 2,000 support structures at INL, with more than 279,000 square meters (3 million square feet) of floor space in varying conditions of utility. INL has approximately 25,100 square meters (270,000 square feet) of covered warehouse space and an additional 18,600 square meters (200,000 square feet) of fenced yard space. The total area of the various machine shops is 3,035 square meters (32,665 square feet) (DOE 2000f).

Fifty-two research and test reactors have been used at INL over the years to test reactor systems, fuel and target design, and overall safety. In addition to nuclear research reactors, other INL facilities are operated to support reactor operations. These facilities include high- and low-level radioactive waste processing and storage sites; hot cells; analytical laboratories; machine shops; and laundry, railroad, and administrative facilities. Other activities include management of one of DOE's largest storage sites for low-level radioactive waste and transuranic waste (DOE 2000f).

The Materials and Fuels Complex (MFC) (formerly known as Argonne National Laboratory-West) is located in the southeastern portion of INL, about 61 kilometers (38 miles) west of the city of Idaho Falls. The MFC is designated as a testing center for advanced technologies associated with nuclear power systems. The MFC has 52 major buildings, including reactor buildings, laboratories, warehouses, technical and administrative support buildings, and craft shops that comprise 55,700 square meters (600,000 square feet) of floor space (DOE 2002d). Five nuclear test reactors have operated at the MFC, although only one is currently active, a small reactor used for radiography examination of experiments, waste containers, and spent nuclear fuel. Principal facilities located at the MFC include the Fuel Manufacturing Facility (FMF), Assembly and Testing Facility, Transient Reactor Test Facility, Fuel Conditioning Facility, Hot Fuel Examination Facility, Zero Power Physics Reactor (ZPPR), and Experimental Breeder Reactor II (EBR-II).

The Reactor Technology Complex (RTC) is located in the southwestern portion of INL. The Materials Test Reactor and Engineering Test Reactor (both shut down), the Reactor Technology Complex Hot Cells, and Advanced Test Reactor (ATR), are located within the RTC. In addition, numerous support facilities (i.e., storage tanks, maintenance buildings, warehouses), laboratories, and sanitary and radioactive waste treatment facilities are in the area (DOE 2000f). The following descriptions of the affected environment at INL, MFC, and RTC are based all or in part on information provided in the *TA-18 Relocation EIS* (DOE 2002d) and the *NI PEIS* (DOE 2000f) which are incorporated by reference.

3.2.1 Land Resources

3.2.1.1 Land Use

The Federal Government, the state of Idaho, and various private parties own lands immediately surrounding INL. Regional land uses include grazing, wildlife management, mineral and energy production, recreation, and crop production. Small communities and towns near the INL boundaries include Mud Lake and Terraton to the east; Arco, Butte City, and Howe to the west; and Atomic City to

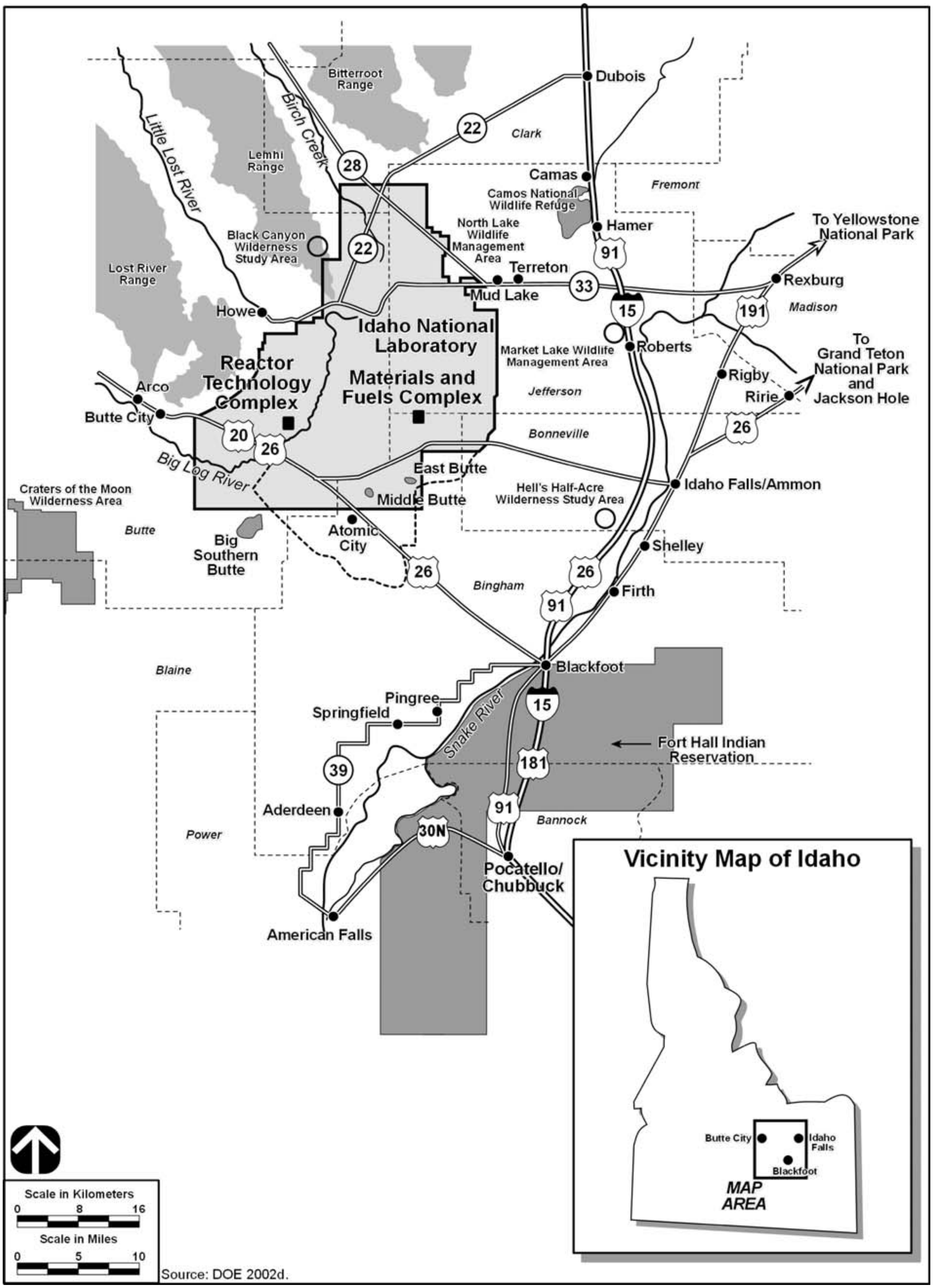

Figure 3–1 Idaho National Laboratory Vicinity

the south. Two national natural landmarks border INL: Big Southern Butte (2.4 kilometers [1.5 miles] south) and Hell's Half Acre (2.6 kilometers [1.6 miles] southeast). A portion of Hell's Half Acre National Natural Landmark is designated as a Wilderness Study Area. The Black Canyon Wilderness Study Area is adjacent to INL, and the Craters of the Moon Wilderness Area is located about 20 kilometers (12 miles) southwest of INL's western boundary. On November 9, 2000, President Clinton signed a Presidential Proclamation that added 267,500 hectares (661,000 acres) to the 21,850-hectare (54,000-acre) Craters of the Moon National Monument, which encompasses this wilderness area.

Land use categories at INL include facility operations, grazing, general open space, and infrastructure such as roads. Approximately 60 percent of the site is used for cattle and sheep grazing. Generalized land uses at INL and the surrounding vicinity are shown in **Figure 3–2**. Facility operations include industrial and support operations associated with energy research and waste management activities. Land is also used for recreation and environmental research associated with the designation of INL as a National Environmental Research Park. Much of INL is open space that has not been designated for specific use. Some of this space serves as a buffer zone between INL facilities and other land uses. Recently, 29,950 hectares (74,000 acres) of open space in the north-central portion of the site were designated as the INL Sagebrush Steppe Ecosystem Reserve. This area represents one of the last sagebrush steppe ecosystems in the United States and provides a home for a number of rare and sensitive species of plants and animals. Approximately 2 percent of the total INL site area (4,600 hectares [11,400 acres]) is used for facilities and operations. Facilities are sited within a central core area of about 93,100 hectares (230,000 acres) (Figure 3–2). Public access to most facilities is restricted. DOE land use plans and policies applicable to INL are discussed in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203 (DOE 1995).

All county plans and policies encourage development adjacent to previously developed areas to minimize the need for infrastructure improvements and to avoid urban sprawl. Because INL is remote from most developed areas, its lands and adjacent areas are not likely to experience residential and commercial development, and no new development is planned near the site. Recreational and agricultural uses, however, are expected to increase in the surrounding area in response to greater demand for recreational areas and the conversion of rangeland to cropland.

The Fort Bridger Treaty of July 3, 1868, secured the Fort Hall Reservation as the permanent homeland of the Shoshone-Bannock Peoples. According to the treaty, tribal members reserved rights to hunting, fishing, and gathering on surrounding unoccupied lands of the United States. While INL is considered occupied land, it was recognized that certain areas on the INL site have significant cultural and religious significance to the tribes. A 1994 Memorandum of Agreement with the Shoshone-Bannock Tribes provides tribal members access to the Middle Butte to perform sacred or religious ceremonies or other educational or cultural activities.

Materials and Fuels Complex

The total land area at MFC is 328 hectares (810 acres); however, site facilities are principally situated within about 20 hectares (50 acres), or 6 percent of the site. MFC is located 7 kilometers (4.3 miles) northwest of the nearest site boundary. Land within the fenced portion of the site has been heavily disturbed, with buildings, parking lots, and roadways occupying most areas and no natural habitat present. The FMF is located within the main fenced portion of the site, while the Transient Reactor Test Facility is located about 1.2 kilometers (0.75 miles) to the northeast. Land within the site will continue to be used for nuclear and nonnuclear scientific and engineering experiments for DOE, private industry, and academia (DOE 2002d).

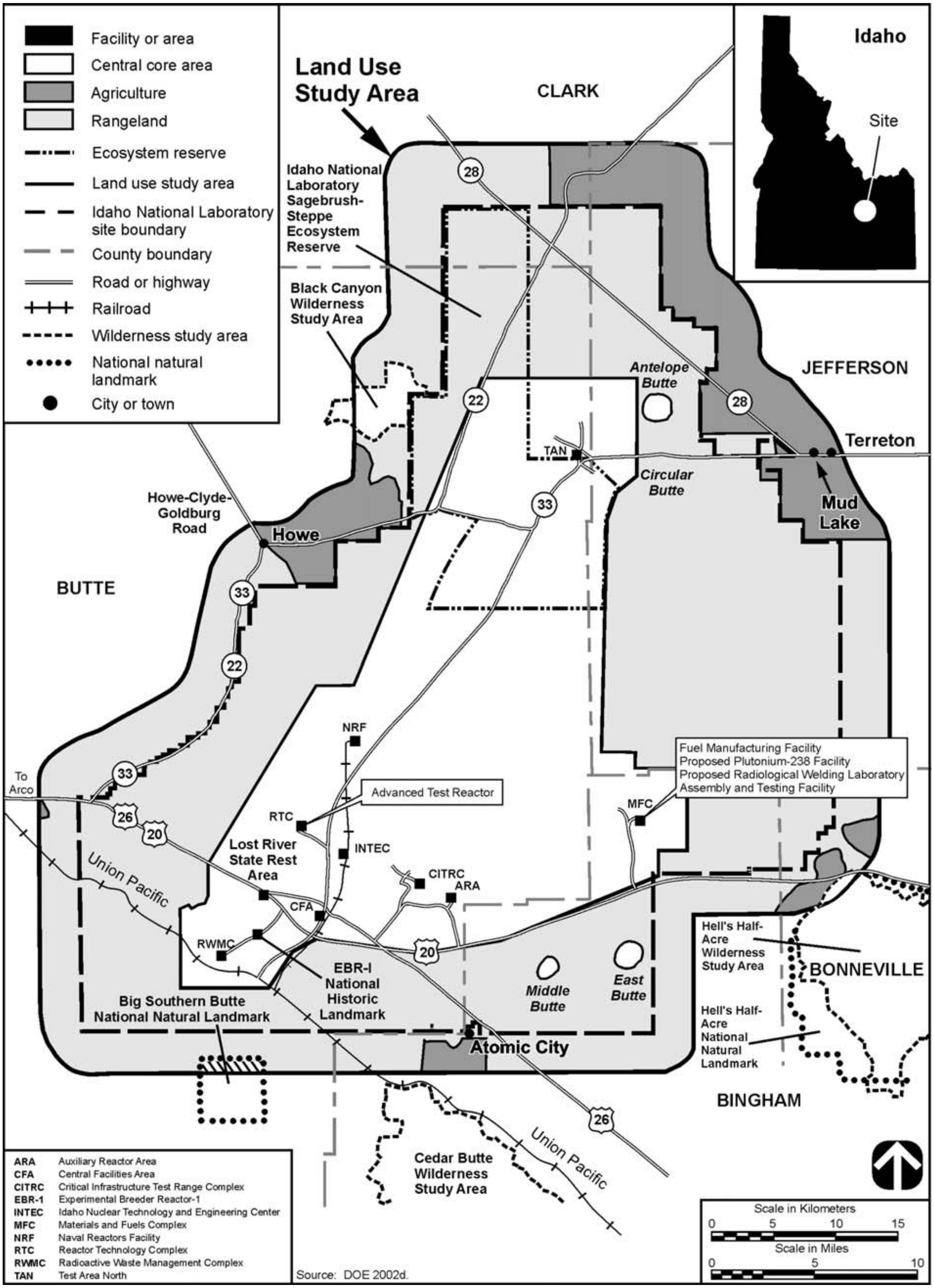

Figure 3–2 Land Use at Idaho National Laboratory and Vicinity

Reactor Technology Complex

Land in the RTC is currently disturbed, and is designated for reactor operations. The area includes about 15 hectares (37 acres) within the security fence, plus several sewage and waste ponds outside of the fence. The RTC is about 11 kilometers (6.8 miles) southeast of the nearest site boundary and about 2.6 kilometers (1.6 miles) northwest of the Big Lost River (DOE 2000f).

Figure 2–12 shows three potential routes for the proposed new road between the MFC and the RTC. Each of these routes include unimproved roads that are subject to maintenance only rarely to ensure that they remain passable in emergency/security situations and for power line maintenance. The northernmost route would follow along the existing T-3 Road (the Old Stagecoach/Jeep Trail), a remote road that currently extends approximately 24 kilometers (15 miles) and passes through undisturbed rangelands. To its south, the T-24 Road extends from MFC approximately 16 kilometers (10 miles) through undisturbed rangelands to the fenced perimeter of the Critical Infrastructure Test Range Complex (CITRC), where it connects to improved interior INL site roads. Further south, the East Power Line Road extends from MFC approximately 19 kilometers (12 miles) until reaching CITRC, and is maintained to a higher level than the T-3 and T-24 roads because of ongoing activities related to the power lines (INL 2005c).

3.2.1.2 Visual Resources

The Bitterroot, Lemhi, and Lost River Mountain ranges border INL on the north and west. Volcanic buttes near the southern boundary of INL can be seen from most locations on the site. INL generally consists of open desert land predominantly covered by big sagebrush and grasslands. Pasture and farmland border much of the site. There are 10 facility areas on the INL site. Although INL has a comprehensive facility and land use plan, no specific visual resource standards have been established. INL facilities have the appearance of low-density commercial/industrial complexes widely dispersed throughout the site. Structure heights generally range from 3 to 30 meters (10 to 100 feet); a few stacks and towers reach 76 meters (250 feet). Although many INL facilities are visible from highways, most are more than 0.8 kilometers (0.5 miles) from public roads (DOE 2000f). The operational areas are well defined at night by security lights.

Lands adjacent to INL are under Bureau of Land Management jurisdiction and have a Visual Resource Contrast Class II rating. Undeveloped lands within the INL site, including the corridors along the potential routes of the new road between the MFC and the RTC, have a Visual Resource Contrast rating consistent with Classes II and III. Management activities within these classes may be seen, but should not dominate the view (DOI 1986). The Black Canyon Wilderness Study Area adjacent to INL is under consideration by the Bureau of Land Management for Wilderness Area designation, approval of which would result in an upgrade of its Visual Resource Contrast rating from Class II to Class I. The Hell's Half Acre Wilderness Study Area is 2.6 kilometers (1.6 miles) southeast of INL's eastern boundary. This area, famous for its lava flow and hiking trails, is managed by the Bureau of Land Management. The Craters of the Moon Wilderness Area is about 20 kilometers (12 miles) southwest of INL's western boundary (DOE 2000f).

Materials and Fuels Complex

Developed areas within MFC are consistent with a Class IV Visual Resource Contrast rating in which management activities dominate the view and are the focus of viewer attention. The tallest structure at MFC is the Fuel Conditioning Facility stack, which is 61 meters (200 feet) in height. The site is visible from Highway 20. Facilities that stand out from the highway include the Transient Reactor Test Facility, Hot Fuel Examination Facility, the EBR-II containment shell, and ZPPR. Natural features of visual interest within a 40-kilometer (25-mile) radius of MFC include the East Butte at 9 kilometers (5.6 miles), Middle Butte at 11 kilometers (6.8 miles), Hell's Half Acre National Natural Landmark and Hell's Half Acre Wilderness Study Area at 15 kilometers (9.3 miles), Big Lost River at 19 kilometers (11.8 miles), and Big Southern Butte National Natural Landmark at 30 kilometers (18.6 miles) (DOE 2002d).

Reactor Technology Complex

Developed areas within the RTC are consistent with a Visual Resource Management Class IV rating. The tallest structure at ATR within the RTC is the main stack, which can be seen from Highways 20, 26, and 22. Natural features of visual interest within a 40-kilometer (25-mile) radius include Big Lost River at 2.6 kilometers (1.6 miles), Middle Butte at 20 kilometers (12 miles), Big Southern Butte National Natural Landmark at 18 kilometers (11 miles), East Butte at 23 kilometers (14 miles), Hell's Half Acre Wilderness Study area at 35 kilometers (22 miles), and Saddle Mountain at 40 kilometers (25 miles) (DOE 2000f).

3.2.2 Site Infrastructure

Characteristics of INL's utility and transportation infrastructure are described below and summarized in **Table 3–2.** Section 3.2.8.4 further discusses local transportation infrastructure, and Section 3.2.11 describes the site's waste management infrastructure.

Table 3–2 Idaho National Laboratory Sitewide Infrastructure Characteristics

Resource	*Site Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	140 [a]	Not applicable
Railroads (kilometers)	48	Not applicable
Electricity		
Energy consumption (megawatt-hours per year)	156,639	481,800
Peak load (megawatts)	36	55
Fuel		
Natural gas (cubic meters per year)	476,000	Not applicable
Fuel oil (heating) (liters per year)	8,700,000	Not limited [b]
Diesel fuel (liters per year)	2,471,000	Not limited [b]
Gasoline (liters per year)	1,444,000	Not limited [b]
Propane (liters per year)	238,940	Not limited [b]
Water (liters per year)	4,200,000,000	43,000,000,000 [c]

[a] Includes asphalt-paved roads.
[b] Capacity is only limited by the ability to ship resources to the site.
[c] Water right allocation.
Note: To convert kilometers to miles, multiply by 0.621; liters to gallons, multiply by 0.264; and cubic meters to cubic feet, multiply by 35.315.
Sources: DOE 2002d, 2002e, 2002f.

3.2.2.1 Ground Transportation

Two interstate highways serve the INL regional area. Interstate 15, a north-south route that connects several cities along the Snake River, is approximately 40 kilometers (25 miles) east of INL. Interstate 86 intersects Interstate 15 approximately 64 kilometers (40 miles) south of INL and provides a primary linkage from Interstate 15 to points west. Interstate 15 and U.S. Highway 91 are the primary access routes to the Shoshone-Bannock reservation. U.S. Highways 20 and 26 are the main access routes to the southern portion of INL and the MFC (see Figure 3–2). Idaho State Routes 22, 28, and 33 pass through the northern portion of INL, with State Route 33 providing access to the northern INL facilities (DOE 2002e). The road network at INL provides for onsite ground transportation. About 140 kilometers (87 miles) of paved surface have been developed out of the 445 kilometers (276 miles) of roads on the site, including 29 kilometers (18 miles) of service roads that are closed to the public (Table 3–2). Most of the roads are adequate for the current level of normal transportation activity and could handle increased traffic volume.

The Union Pacific Railroad's Blackfoot-to-Arco Branch crosses the southern portion of INL and provides rail service to the site. This branch connects with a DOE spur line at Scoville Siding, then links with developed areas within INL. There are 48 kilometers (30 miles) of railroad track at INL. Rail shipments to and from INL usually are limited to bulk commodities, spent nuclear fuel, and radioactive waste (DOE 2002d).

3.2.2.2 Electricity

DOE presently contracts with the Idaho Power Company to supply electric power to INL. The contract allows for power demand of up to 45,000 kilowatts (45 megawatts), which can be increased to 55,000 kilowatts (55 megawatts) by notifying Idaho Power in advance. Power demand above 55,000 kilowatts is possible but would have to be negotiated with Idaho Power. Idaho Power transmits power to INL via a 230-kilovolt line to the Antelope substation, which is owned by PacifiCorp (Utah Power Company). PacifiCorp also has transmission lines to this substation, which provides backup in case of problems with the Idaho Power system. At the Antelope substation, the voltage is dropped to 138 kilovolts, then transmitted to the DOE-owned Scoville substation via two redundant feeders. The INL transmission system is a 138-kilovolt, 105-kilometer (65-mile) loop configuration that encompasses seven substations, where the power is reduced to distribution voltages for use at the various INL facilities. The loop allows for a redundant power feed to all substations and facilities (DOE 2002e).

Site electrical energy availability is about 481,800 megawatt-hours per year based on the contract load limit of 55,000 kilowatts (55 megawatts) for 8,760 hours per year. Current electrical energy consumption at INL is 156,639 megawatt-hours annually (based on 2000 data) (DOE 2002f). The recorded peak load was about 39 megawatts (DOE 2002e); the contract-limited peak load capacity for INL is 55 megawatts (Table 3–2). Current electrical usage at MFC is about 28,700 megawatt-hours per year (DOE 2002d).

3.2.2.3 Fuel

Fuel consumed at INL includes natural gas, fuel oil (heating fuel), diesel fuel, gasoline, and propane. All fuels are transported to the site for use and storage. Fuel storage is provided for each facility, and the inventories are restocked as necessary (DOE 2002d). INL site-wide fuel oil consumption was approximately 8,700,000 liters (2,300,000 gallons) in 2000, while natural gas consumption was about 476,000 cubic meters (16,816,000 cubic feet) during the same time period. Total diesel fuel consumption was about 2,471,000 liters (652,900 gallons), total gasoline consumption was about 1,444,000 liters (381,347 gallons), and total propane consumption was about 238,940 liters (63,121 gallons) (see Table 3–2) (DOE 2002f).

In 2001, MFC used 2,000,000 liters (549,000 gallons) of fuel oil, down from a peak of 2,500,000 liters (657,000 gallons) used in 1995. The usage of fuel oil varies with the severity of the winters (DOE 2002f).

3.2.2.4 Water

The Snake River Plain Aquifer is the source of all water used at INL. The water is provided by a system of about 30 wells, together with pumps and storage tanks. That system is administered by DOE, which holds the Federal Reserved Water Right of 43 billion liters (11.4 billion gallons) per year for the site (DOE 2002d). INL site-wide groundwater production and usage is approximately 4,200 million liters (1,100 million gallons) annually (see Table 3–2) (DOE 2002e). INL discharges result in a much smaller net water use than what is pumped from the aquifer. The MFC water supply and distribution system is a combination fire-protection, potable, and service water system supplied from an underground aquifer via two onsite deep production wells. The deep wells (EBR-II #1 and EBR-II #2) have a pumping capacity of 3,400 liters (900 gallons per minute) (or 1,790 million liters [473 million gallons] annually). Well water is pumped to a 757,000-liter (200,000-gallon) primary storage tank and then through the distribution system for potable, service, and fire-protection use. A second 757,000-liter (400,000-gallon) water storage tank is reserved for fire protection and maintained at full capacity. The deep wells can be valved to either storage tank or directly to the distribution system, if necessary. Currently, MFC water demand and usage from its two production wells is approximately 182 million liters (48 million gallons) annually (ANL 2003).

3.2.3 Geology and Soils

3.2.3.1 Geology

INL occupies a relatively flat area on the northwestern edge of the Eastern Snake River Plain, part of the Eastern Snake River Plain Physiographic Province. The area consists of a broad plain that has been built up from the eruptions of multiple flows of basaltic lava over the past 4 million years. Four northwest-trending volcanic rift zones which cut across the Eastern Snake River Plain have been identified as the source areas for these eruptions. The Eastern Snake River Plain is bounded on the north and south by the north-to-northwest-trending mountains of the northern Basin and Range Physiographic Province, with peaks up to 3,660 meters (12,000 feet) in height separated by intervening basins filled with terrestrial sediments and volcanic rocks. The peaks are sharply separated from the intervening basins by late Tertiary to Quaternary normal faults. The basins are 5 to 20 kilometers (3 to 12 miles) wide and grade onto the Eastern Snake River Plain. Several northwest-trending front-range faults have been mapped in the immediate vicinity of INL. To the northeast, the Eastern Snake River Plain is bounded by the Yellowstone Plateau (ANL 2003, DOE 2002e). **Figure 3–3** shows the major geologic features of INL and vicinity.

The mountains northwest of the Eastern Snake River Plain and near INL are composed of thick sequences of late Precambrian through Pennsylvanian sedimentary strata, mostly limestones. They occurred within westward-dipping thrust sheets that formed during east-directed compression (ANL 2003). The upper 1 to 2 kilometers (0.6 to 1.2 miles) of the crust beneath INL is composed of a sequence of Quaternary age (recent to 2 million years old) basalt lava flows and poorly consolidated sedimentary interbeds collectively called the Snake River Group. The lava flows at the surface range from 2,100 to 2 million years old (DOE 2002e, 2002d). The sediments are composed of fine-grained silts that were deposited by wind; silts, sands, and gravels deposited by streams; and clays, silts, and sands deposited in lakes such as Mud Lake and its much larger ice-age predecessor, Lake Terreton. The accumulation of these materials in the Eastern Snake River Plain has resulted in the observed sequence of interlayered basalt lava flows and sedimentary interbeds. Basaltic volcanism on the Eastern Snake River Plain has been a sporadic process. During the long periods of inactivity between volcanic events, sediments accumulated to thicknesses of less than 1 meter (3.3 feet) to greater than 60 meters (197 feet). During short periods of volcanic activity, several lava flows commonly accumulated to thicknesses reaching several tens of

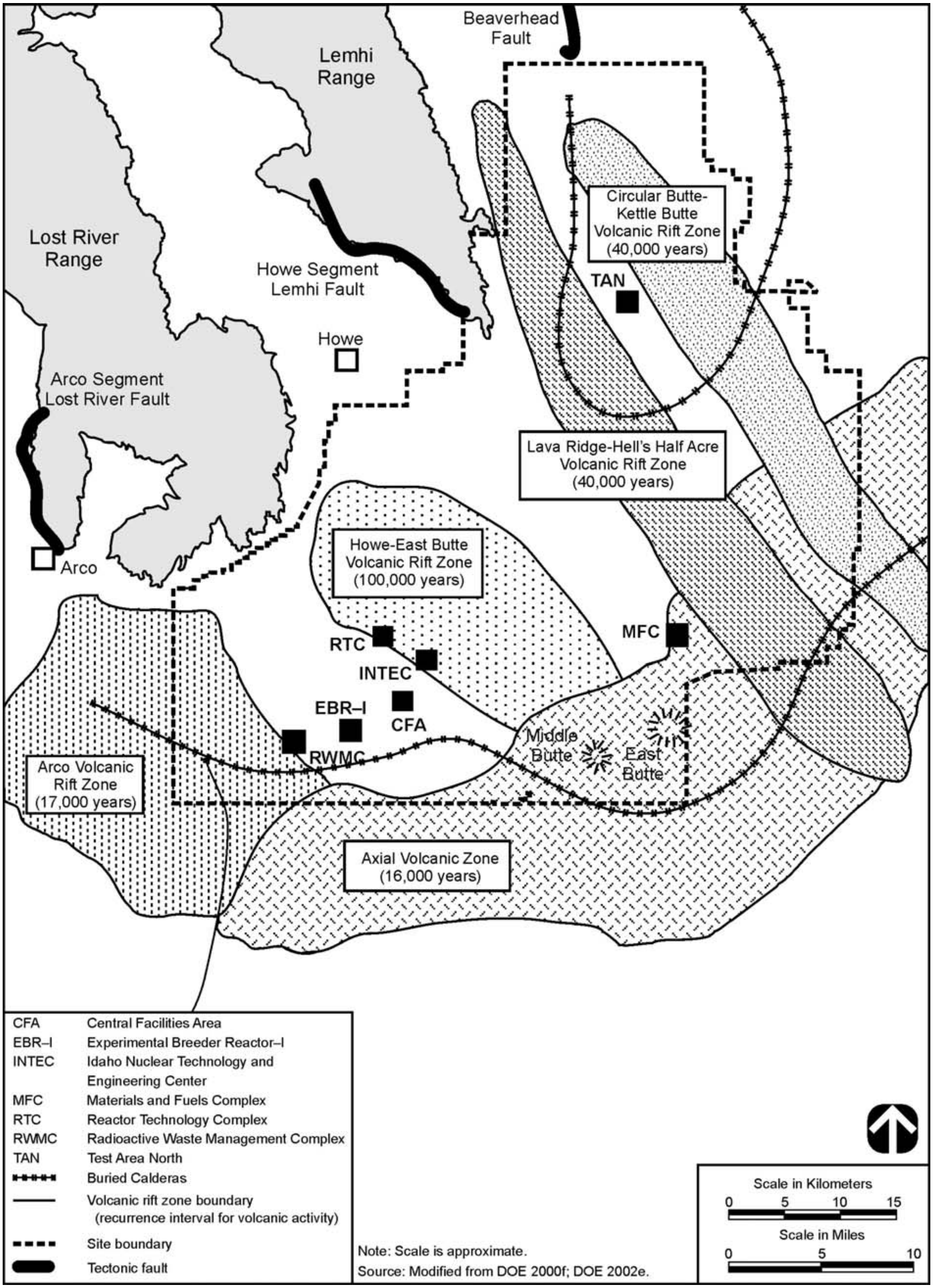

Figure 3–3 Major Geologic Features of Idaho National Laboratory

meters. Basalt lava flows were erupted from vents concentrated in the four volcanic rift zones and along the central axis of the Eastern Snake River Plain (the Axial Volcanic Zone) (see Figure 3–3). The basalts, along with intercalated sediments, are underlain by a great thickness of rhyolitic volcanic rocks that were erupted when the area was over the Yellowstone hotspot, more than 4 million years ago (ANL 2003). **Figure 3–4** depicts the general stratigraphy beneath INL.

Several Quaternary rhyolite domes are located along the Axial Volcanic Zone near the south and southeast borders of INL. Their names and ages are Big Southern Butte (300,000 years), a rhyolite dome near Cedar Butte (400,000 years), East Butte (600,000 years), Middle Butte (age unknown), and an unnamed butte near East Butte (1.2 million years). Paleozoic carbonate rocks (limestones), late-Tertiary rhyolitic volcanic rocks, and large alluvial fans are located in limited areas along the northwest margin of INL. A wide band of Quaternary mainstream alluvium (unconsolidated gravels and sands) extends along the course of the Big Lost River from the southwestern corner of INL to the Big Lost River Sinks area in north-central INL. Lacustrine (lake) deposits of clays and sands deposited in ice-age Lake Terreton are located in the northern part of INL. Beach sands deposited at the high stand of Lake Terreton were reworked by winds in late Pleistocene and Holocene times to form large dune fields (eolian deposits) in the northeastern part of INL. Elsewhere on INL, the basaltic lava flows are variably covered with a thin veneer of eolian silt (loess), which can be up to several meters thick, but mostly range from 0 to 1 meter (3.3 feet) or 2 meters (6.6 feet) thick (ANL 2003).

Within INL, mineral resources include sand, gravel, pumice, silt, clay, and aggregate (e.g., sand, gravel, and crushed stone). These resources are extracted at several quarries or pits at INL and used for road construction and maintenance, new facility construction and maintenance, waste burial activities, and ornamental landscaping. The geologic history of the Eastern Snake River Plain makes the potential for petroleum production at INL very low. The potential for geothermal energy exists at INL and in parts of the Eastern Snake River Plain; however, a study conducted in 1979 identified no economic geothermal resources (DOE 2002e).

The Arco Segment of the Lost River Fault is thought to terminate about 7 kilometers (4.3 miles) from the INL boundary. The Howe Segment of the Lemhi Fault terminates near the northwest boundary of the site (Figure 3–3). Both segments are considered capable or potentially active. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years, or recurrent movement within the past 500,000 years (10 CFR Part 100).

The seismic characteristics of the Eastern Snake River Plain and the adjacent Basin and Range Province are different. The Eastern Snake River Plain has historically experienced infrequent small-magnitude earthquakes. In contrast, the major episode of Basin and Range faulting that began 20 to 30 million years ago continues today. Since the installation of INL's seismic network in 1971, only 29 microearthquakes (magnitude less than 1.5) have been detected within the Eastern Snake River Plain. However, INL's seismic stations record about 2,000 annually elsewhere in southeast Idaho (Bechtel BWXT Idaho 2003). Thus, the Eastern Snake River Plain and INL have a relatively low seismicity as compared to adjacent regions.

The largest historic earthquake near INL took place on October 28, 1983, about 90 kilometers (56 miles) northwest of the western site boundary, near Borah Peak in the Lost River Range (part of the Basin and Range). It occurred on the middle portion of the Lost River Fault. The earthquake had a surface-wave magnitude of 7.3 (moment magnitude of 6.9). The reported Modified Mercalli Intensity (MMI) ranged from V to IX at the event's epicenter. The RTC experienced an MMI of VI during this event with no damage to the ATR (DOE 2002d). Since 1973, 25 earthquakes have been recorded within 100 kilometers (62 miles) of south-central INL ranging in magnitude from 2.8 to 3.9. These represent minor earthquakes,

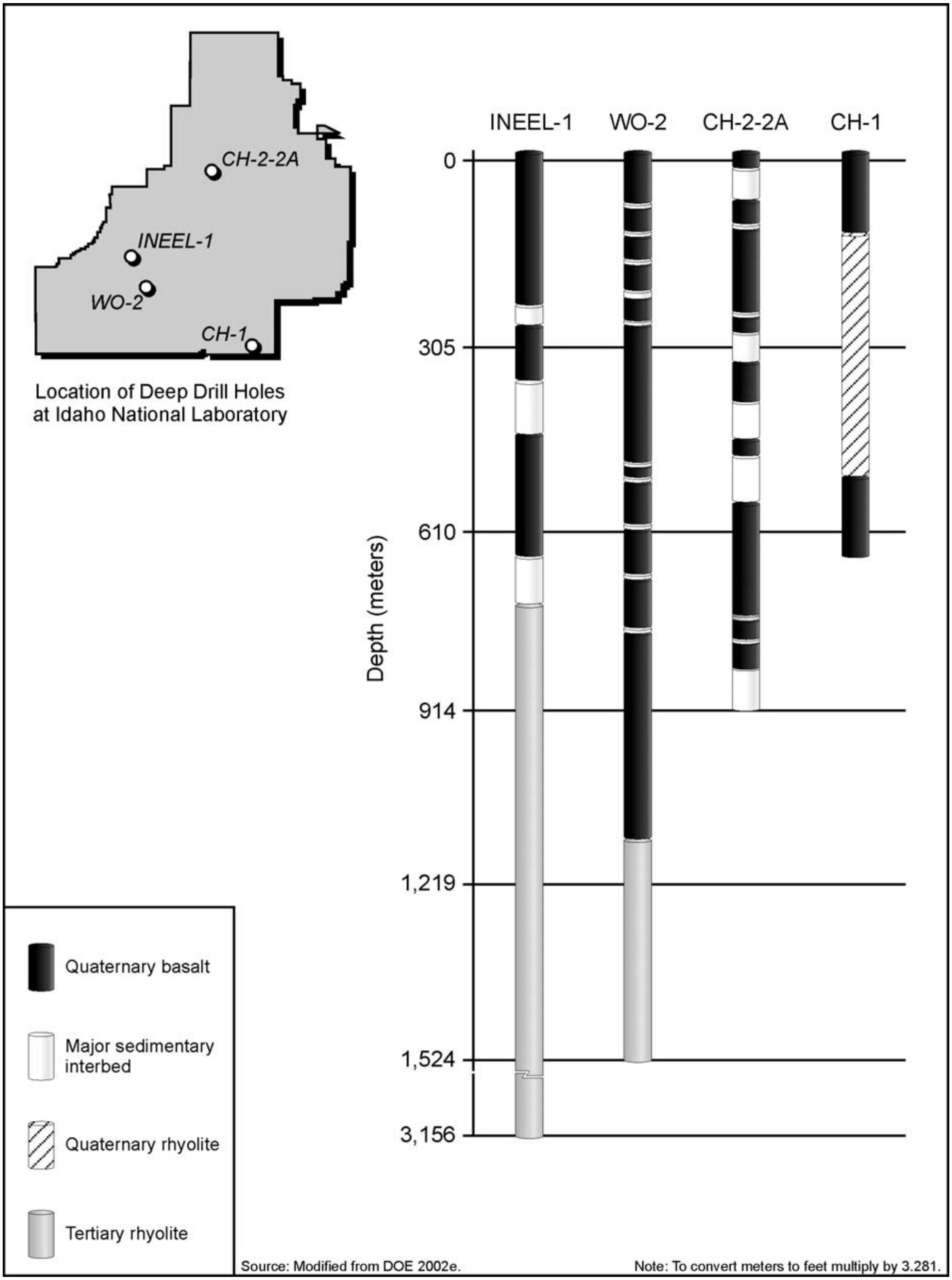

Figure 3–4 Lithologic Logs of Deep Drill Holes on Idaho National Laboratory

with none centered closer than 76 kilometers (47 miles) from the south-central portion of the site (USGS 2005a).

Earthquake-produced ground motion is expressed in units of “g” (force of acceleration relative to that of the earth’s gravity). Two differing measures of this motion are peak (ground) acceleration and response spectral acceleration. New seismic hazard metrics and maps developed by the U.S. Geological Survey have been adapted for use in the International Building Code and depict maximum considered earthquake ground motion of 0.2- and 1.0-second spectral acceleration, respectively, based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability of occurrence of about 1 in 2,500. Appendix B of this EIS provides a more detailed explanation of these maps and their use. For south-central INL facilities, the calculated maximum considered earthquake ground motion ranges from approximately 0.31g for an 0.2-second spectral response acceleration to 0.13g for a 1.0-second spectral response acceleration. The calculated peak ground acceleration for the given probability of exceedance at the site is approximately 0.13g (USGS 2005b).

Based on the maximum considered earthquake ground motions, INL is located in the broadly defined region of low and moderate to high seismicity. Ground motions in these regions are controlled by earthquake sources that are not well defined, with estimated maximum earthquake magnitudes having relatively long return periods. Maximum considered earthquake ground motions encompass those that could cause substantial structural damage to buildings, thus presenting safety concerns for occupants (equivalent to an MMI of VII and up). Specifically, maximum considered earthquake ground motions of about 0.50g at 0.2 seconds and 0.20g at 1.0 second are representative of MMI VII earthquake damage (BSSC 2004). For comparison, the aforementioned Borah Peak earthquake produced peak horizontal (ground) accelerations ranging from 0.022g to 0.078g at INL (DOE 2002e). Table B–7 in Appendix B of this EIS shows the approximate correlation between MMI, earthquake magnitude, and peak ground acceleration.

Earthquakes greater than moment magnitude 5.5 and associated strong ground shaking and surface fault rupture are not likely to occur within the Eastern Snake River Plain, based on its seismic history and geology. Moderate to strong ground shaking from earthquakes in the Basin and Range could affect INL (DOE 2002e). Consequently, INL has supported efforts to estimate the levels of ground shaking that can be expected at INL facilities from all earthquake sources in the region. The estimates are in the form of levels of ground shaking that would not be exceeded in specified time periods. A probabilistic ground motion study for all facility areas was finalized in 2000. The INL ground motion evaluation incorporated results of all geologic, seismologic, and geophysical investigations conducted by many investigators since the 1960s. Fault segments closest to INL facilities, the Lost River and Lemhi Faults, were studied in detail to estimate their maximum earthquake magnitudes, distances to INL facilities, when the last earthquakes occurred, and how often they have occurred in the past. The results of these investigations indicate that these faults are capable of generating earthquakes of magnitude 7 to 7.2 and that the most recent earthquakes occurred more than 15,000 years ago (Bechtel BWXT Idaho 2003).

INL seismic design basis events are incorporated into the INL Architectural and Engineering Standards based on seismic studies. New facilities and facility upgrades are designed in accordance with the requirements specified in applicable DOE standards and orders (DOE 2002e). As stated in DOE Order 420.1A, DOE requires that nuclear or nonnuclear facilities be designed, constructed, and operated so that the public, workers, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes. The mean peak ground acceleration, determined by the INL Natural Phenomena Hazards Committee, has been incorporated into the architectural and engineering standards.

Basaltic volcanic activity occurred from about 2,100 to 4 million years ago in the INL site area. Although no eruptions have occurred on the Eastern Snake River Plain during recorded history, lava flows of the Hell's Half Acre lava field erupted near the southern INL boundary as recently as 5,400 years ago. The most recent eruptions within the area occurred about 2,100 years ago 30 kilometers (19 miles) southwest of the site at the Craters of the Moon Wilderness Area. The estimated recurrence interval for volcanism associated with the five identified volcanic zones ranges from 16,000 to 100,000 years (DOE 2002d). These zones are depicted in Figure 3–3.

3.2.3.2 Soils

Four basic soilscapes exist at INL: river-transported sediments deposited on alluvial plains, fine-grained sediments deposited into lake or playa basins, colluvial sediments originating from bordering mountains, and wind-blown sediments over lava flows. The alluvial deposits follow the courses of the modern Big Lost River and Birch Creek. The playa soils are found in the north-central part of the site. The colluvial sediments are located along the western edge of INL. Wind-blown sediments (silt and sand) covering lava plains occupy the rest of the landscape of the site. The thickness of surficial sediments ranges from less than 0.3 meters (1 foot) at basalt outcrops east of the Idaho Nuclear Technology and Engineering Center (INTEC) to 95 meters (312 feet) near the Big Lost River sinks. No soils designated as prime farmland exist within INL boundaries (DOE 2002d).

Materials and Fuels Complex

The nearest capable fault to MFC is the Howe Segment of the Lemhi Fault, which is located 31 kilometers (19 miles) northwest of the site. MFC is located within the Axial Volcanic Zone, which has an estimated recurrence interval for volcanism of 16,000 years. The site is situated within a topographically closed basin. Low ridges of basalt found east of the area rise as high as 30 meters (100 feet) above the level of the plain. Sediments cover most of the underlying basalt on the plain, except where pressure ridges form basalt outcrops. Soils in the MFC area generally consist of light brown-gray well-drained silty loams to brown extremely stony loams. Soils are highly disturbed within developed areas of the site (DOE 2002d).

Reactor Technology Complex

The nearest capable fault to the RTC is the Howe Segment of the Lemhi Fault, which is about 19 kilometers (12 miles) north-northeast of ATR. Surficial materials within the site area consist of Big Lost River alluvium comprised mostly of gravel, gravelly sands, and sands ranging from 9 to 15 meters (30 to 50 feet) in depth. A relatively thin layer of silt and clay underlies the alluvium in some locations creating a low-permeability layer at the basalt bedrock interface. These sediments overlie the interbedded basalts of the Snake River Group, with basaltic rock exposed at the surface to the north and west of the RTC. The sedimentary interbeds of the Snake River Group consist mainly of silts, clayey silts, and sandy silts. There is no potential for unstable conditions due to lava tubes at the site. Soils on the site, although highly disturbed by existing facilities, are derived from the Big Lost River alluvium. The soils and sediments are not subject to liquefaction (DOE 2000f).

3.2.4 Water Resources

3.2.4.1 Surface Water

INL is in the Mud Lake-Lost River Basin (also known as the Pioneer Basin). This closed drainage basin includes three main streams—the Big and Little Lost Rivers and Birch Creek (**Figure 3–5**). These three

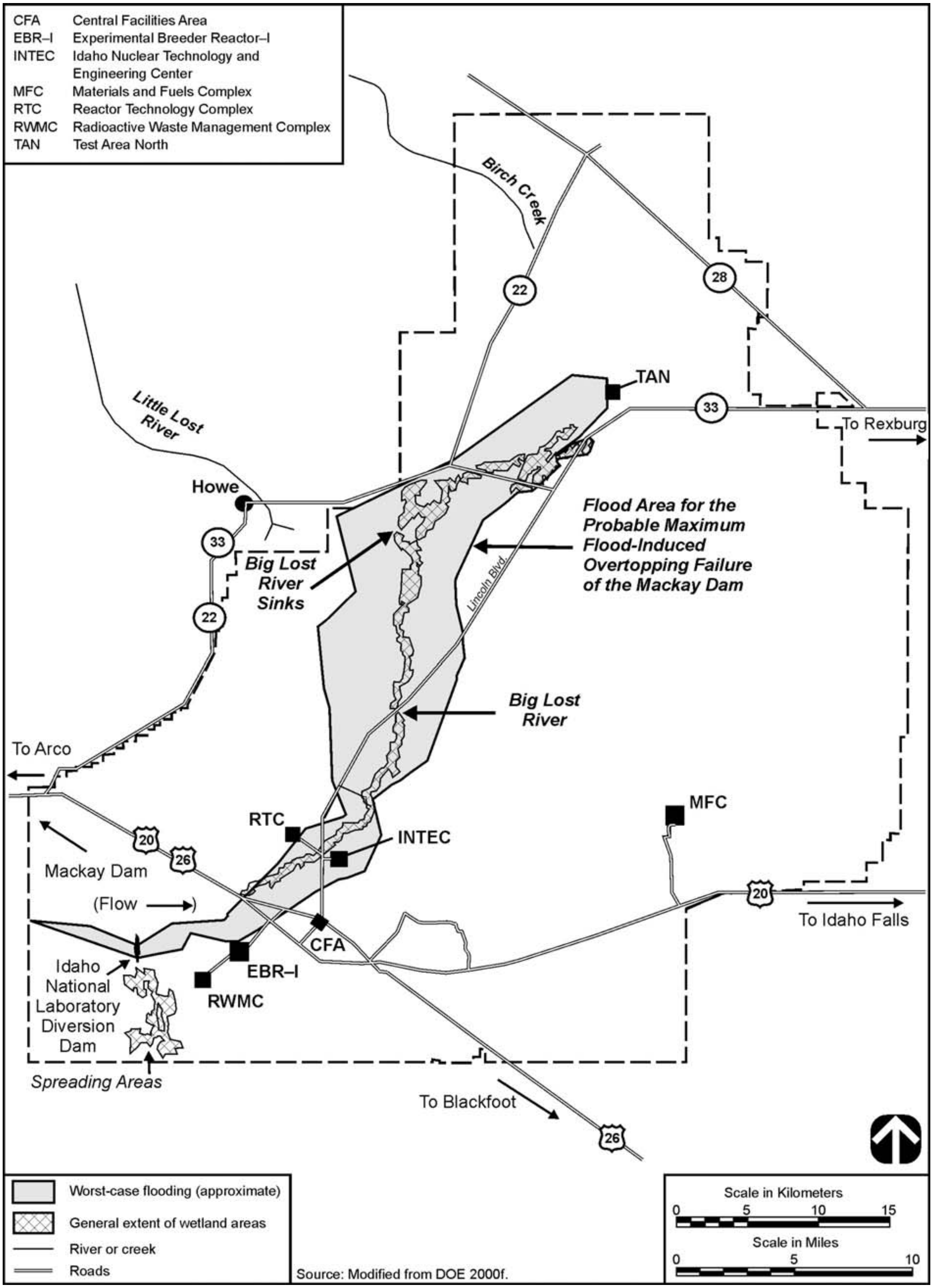

Figure 3–5 Surface Water Features at Idaho National Laboratory

streams are essentially intermittent and drain the mountain areas to the north and west of INL, although most flow is diverted for irrigation in the summer months before it reaches the site boundaries. Flow that reaches INL infiltrates the ground surface along the length of the streambeds in the spreading areas at the southern end of INL and, if the streamflow is sufficient in the ponding areas (playas or sinks) in the northern portion of INL. During dry years, there is little or no surface water flow on the INL site. Because the Mud Lake-Lost River Basin is a closed drainage basin, water does not flow off INL, but instead infiltrates the ground surface to recharge the aquifer or is consumed by evapotranspiration. The Big Lost River flows southeast from Mackay Dam, past Arco and onto the Snake River Plain. On the INL site near the southwestern boundary, a diversion dam prevents flooding of downstream areas during periods of heavy runoff by diverting water to a series of natural depressions or spreading areas. During periods of high flow or low irrigation demand, the Big Lost River continues northeastward past the diversion dam, passes within about 60 meters (200 feet) of INTEC, and ends in a series of playas 24 to 32 kilometers (15 to 20 miles) northeast of INTEC and RTC, where the water infiltrates the ground surface.

Flow from Birch Creek and the Little Lost River infrequently reaches INL. The water in Birch Creek and Little Lost River is diverted in summer months for irrigation prior to reaching INL. During periods of unusually high precipitation or rapid snow melt, water from Birch Creek and Little Lost River can enter INL from the northwest and infiltrate the ground, recharging the underlying aquifer.

Other than the three intermittent streams, the only other surface water bodies on the site include natural wetland-like ponds and manmade percolation and evaporation ponds (DOE 2002d). The latter are used for wastewater management at INL. Discharges to the ground surface are through infiltration ponds, trenches, and a sprinkler irrigation system. Infiltration ponds include the INTEC New Percolation Ponds, Test Area North/Technical Support Facility Sewage Treatment Plant Disposal Pond, RTC, Cold Waste Pond, MFC Industrial Waste Pond and ditch, MFC Sanitary Lagoons, and the Naval Reactors Facility (NRF) Industrial Waste Ditch. Also at INTEC, wastewater is discharged to the INTEC Sewage Treatment Plant and associated infiltration trenches, and through a sprinkler irrigation system at the Central Facilities Area, used during the summer months to land-apply industrial and treated sanitary wastewater (DOE 2004f).

Discharge of wastewater to the land surface is regulated under Idaho Wastewater-Land Application Permit rules (IDAPA 2004c). An approved Wastewater-Land Application Permit normally requires monitoring of nonradioactive parameters in the influent waste, effluent waste, and groundwater, as applicable. The Wastewater-Land Application Permits generally require compliance with Idaho groundwater quality primary constituent standards and secondary constituent standards in specified groundwater monitoring wells (IDAPA 2004b). The permits specify annual discharge volume, application rates, and effluent quality limits. As required, an annual report is prepared and submitted to the Idaho Department of Environmental Quality (DOE 2004f).

Waterbodies in Idaho are designated by the Department of Environmental Quality to protect water quality for existing or other designated uses. Big Lost River, Little Lost River, and Birch Creek in the vicinity of INL have been designated for cold water aquatic communities, salmonid spawning, and primary contact recreation, with the Big Lost River sinks and channel and lowermost Birch Creek also classified for domestic water supply and as special resource waters (IDAPA 2004a). In general, the water qualities of the Big Lost River, Little Lost River, and Birch Creek are similar, with the chemical qualities reflecting the carbonate mineral compositions of the mountain ranges drained by them along with the quality of irrigation water return flows. Surface waters, however, are not used for drinking water on the site, nor is effluent discharged directly to them, so there are no surface water rights issues at INL. None of the rivers or streams on or near the INL site have been classified as Wild and Scenic (DOE 2002d).

Although there are no routine process wastewater discharges to surface waters, DOE maintains compliance with National Pollutant Discharge Elimination System (NPDES) permit provisions including the *NPDES General Permit for Storm Water Discharges from Industrial Activities* and *NPDES General Permit for Storm Water Discharges from Construction Activities*. Revised requirements for the *NPDES General Permit for Storm Water Discharges from Industrial Activities* became effective in 2000. A modified *NPDES Storm Water Multi-Sector General Permit for Industrial Activities* was also published in 2000 and INL gained coverage under this permit in January 2001. The Environmental Monitoring Unit of the management and operations contractor monitors storm water in accordance with permit requirements. Results are reported in the annual site environmental reports. *INL's General Permit for Storm Water Discharges from Construction Sites* was issued in June 1993. The permit has been renewed twice since issuance. The *INL Storm Water Pollution Prevention Plan for Construction Activities* provides measures and controls to prevent pollution of storm water from construction activities at INL. Worksheets are completed for construction projects and are appended to the plan. Inspections of construction sites are performed in accordance with permit requirements (DOE 2003c).

In accordance with NPDES permit provisions, 68 visual storm water examinations were performed at 22 locations in 2003. No rainfall, snowmelt, or discharge down injection wells was observed at 14 monitoring points; therefore, no visual examinations were performed or analytical samples collected at those locations. The visual examinations performed in 2003 showed satisfactory implementation of the *INEEL Storm Water Pollution Prevention Plan for Industrial Activities*, and no corrective actions were required or performed during the year. Analytical samples were collected for qualifying rain events that potentially discharged to waters of the United States at applicable monitoring locations. Potential discharges to waters of the United States from a qualifying storm occurred at two locations at the Radioactive Waste Management Complex and the T-28 North gravel pit. Although the potential for discharge to waters of the United States exists, there was no indication that such a discharge occurred for these events. The measured concentrations for total suspended solids, iron, magnesium, and chemical oxygen demand exceeded the benchmark concentration levels at both locations for one or more samples. These parameters have been above benchmark concentrations at these locations in the past. No deficiencies in pollution prevention practices have been identified in these areas that would lead to high concentrations for these parameters, and no definite cause has been identified. However, iron and magnesium are common soil-forming minerals and may be attributed to suspended sediment, deposited onsite from high winds and landfill operations, in the storm water discharge. Storm drain filters for petroleum and sediment are in place and maintained regularly to provide additional pollution prevention (DOE 2004f).

Surface water locations outside of the INL boundary are sampled twice a year for gross alpha, gross beta, and tritium. In 2003, 12 surface water samples from 5 offsite locations were collected along the Snake River. One sample had a detectable gross alpha concentration of 1.53 picocuries per liter compared to the U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) of 15 picocuries per liter. Nine of 12 samples had measurable gross beta activity, while only 1 sample had measurable tritium. Detectable gross beta activity levels ranged from 3.13 to 8.01 picocuries per liter, as compared to the EPA screening level of 50 picocuries per liter. Concentrations in this range are consistent with those measured in the past and cannot be differentiated from natural decay products of thorium and uranium that dissolve into water as the water passes through the surrounding basalts of the Eastern Snake River Plain. The highest tritium concentration was 94.7 picocuries per liter, as compared to the EPA MCL in drinking water of 20,000 picocuries per liter (DOE 2003c, 2004f).

Flooding on the Big Lost River was evaluated for potential impact on INL facilities, including an examination of flooding potential due to the failure of Mackay Dam, 72 kilometers (45 miles) upstream of the INL, from a probable maximum flood (see Figure 3–5). The maximum flood evaluated was assumed to result in the overtopping and rapid failure of Mackay Dam. This flood would result in a peak surface water elevation at INTEC of 1,499 meters (4,917 feet), with a peak flow of 1,892 cubic meters (66,830 cubic feet) per second in the Big Lost River measured near INTEC. The average elevation at INTEC is 1,499 meters (4,917 feet). At this peak water surface elevation, portions of INTEC would be flooded, especially at the north end. The RTC would not be flooded, however. Because the ground surface at INL and INTEC is relatively flat, floodwaters outside the banks of the Big Lost River would spread over a large area and pond in the lower lying areas. Although predicted flood velocities would be relatively slow with shallow water depths, some facilities could be impacted. There is no record of any historical flooding at INTEC from the Big Lost River, although evidence of flooding in geologic time exists (DOE 2002e). The INL diversion dam, constructed in 1958 and enlarged in 1984, was designed to secure INL from the 300-year flood (estimated peak flow of slightly above 142 cubic meters [5,000 cubic feet] per second) of the Big Lost River by directing flow through a diversion channel into four spreading areas (DOE 2002d). The effects of systematic (non-instantaneous) failure of the diversion dam were included in the flood analysis.

Additional work is currently being performed by DOE at INL to further refine the floodplain boundaries of the Big Lost River as a basis to support future flood hazard assessments. The results of this effort, if available, will be included in the Final *Consolidation EIS* (see Appendix F).

Materials and Fuels Complex

There are no named streams within the MFC area and no permanent natural surface water features near the area. Neither the 100-year flood nor flooding scenarios that involve the failure of Mackay Dam on the Big Lost River indicate that floodwaters would reach MFC (Figure 3–5).

Nevertheless, an unnamed dry streambed lies within several hundred feet of the Transient Reactor Test Facility Control Building adjacent to the main MFC site. As much as 1.5 million cubic meters (53 million cubic feet) of water could flow within a few hundred feet of the Transient Reactor Test Facility Control Building during a 100-year storm if worst-possible frozen-ground conditions existed. In addition, a flood-control diversion dam is located about 805 meters (0.5 miles) south of the Hot Fuel Examination Facility. This dam was built to control surface water flows from the south from severe spring-weather precipitation with frozen ground (inhibiting groundwater absorption that could affect the MFC site). Water flowing from the south is diverted to the west and through a ditch along the western boundary of the MFC site; this ditch discharges to the Industrial Waste Pond (ANL 2003).

Two small sewage lagoons and the Industrial Waste Pond are located outside the MFC boundary fence to the northwest. The 1-hectare (2.4-acre) Industrial Waste Pond is used for disposal of industrial cooling and storm water emanating from MFC facilities (ANL 2003).

Reactor Technology Complex

There are no named streams within the RTC; there are only unnamed drainage ditches that carry storm flows away from buildings and facilities at the site. Neither the 100-year flood nor flooding scenarios that involve the failure of the Mackay Dam indicate floodwaters would inundate the RTC (DOE 2000f).

3.2.4.2 Groundwater

The Snake River Plain Aquifer lies below the INL site. It covers an area of approximately 25,000 square kilometers (9,600 square miles) in southeastern Idaho. Aquifer boundaries are formed by contact of the aquifer with less permeable rocks at the margins of the Eastern Snake River Plain. These boundaries correspond to the mountains on the west and north and the Snake River on the east (ANL 2003). This aquifer is the major source of drinking water for southeastern Idaho and has been designated a Sole

Source Aquifer by EPA (DOE 2002d and 2002e). Water storage in the aquifer is estimated at some 2,500 billion cubic meters (2 billion acre-feet), and irrigation wells can yield 26,000 liters (7,000 gallons) per minute (DOE 2002e). The aquifer is composed of numerous relatively thin basalt flows with interbedded sediments extending to depths in excess of 1,067 meters (3,500 feet) below land surface. Figure 3–4 shows the relationship of these strata from boreholes drilled at INL. The interbeds accumulated over time as some basalt flows were exposed at the surface long enough to collect sediment. These sedimentary interbeds lie at various depths, with their distribution and continuity controlled by basalt flow topography, sediment input, and subsidence rate. In some instances, the process of sediment accumulation resulted in discontinuous distributions of relatively impermeable sedimentary interbeds which led to localized perching of groundwater. The U.S. Geological Survey has estimated that the thickness of the active portion of the Snake River Plain Aquifer at INL ranges between 75 and 250 meters (250 to 820 feet). Depth to the water table ranges from about 60 meters (200 feet) below land surface in the northern part of the site to more than 274 meters (900 feet) in the southern part (ANL 2003).

Water in the aquifer mainly moves horizontally on a regional basis through basalt interflow zones, which are comprised of highly permeable rubble zones between basalt flows. Groundwater flow is primarily toward the southwest. On a local basis, the flow direction can be affected by recharge from rivers, surface water spreading areas, and heterogeneities in the aquifer. Transmissivity in the aquifer ranges from roughly 100 to 10,000 square meters (1,000 to 100,000 square feet) per day and, in places, exceeds 100,000 square meters (1 million square feet) per day (ANL 2003). Later flow rates in the aquifer have been reported to range from about 1.5 to 6.1 meters (5 to 20 feet) per day (DOE 2002d).

The Big Lost River, Little Lost River, and Birch Creek terminate at sinks on or near INL and recharge the aquifer. Recharge occurs through the surface of the Eastern Snake River Plain from flow in the channel of the Big Lost River and its diversion area. Additionally, recharge may occur from melting of local snowpacks during years in which snowfall accumulates on the Eastern Snake River Plain and from local agricultural-irrigation activities (ANL 2003). Valley underflow from the mountains to the north and northeast of the Eastern Snake River Plain has also been cited as a source of recharge (DOE 2002e). Aquifer discharge is via large spring flows to the Snake River and water pumped for irrigation. The aquifer discharges approximately 8.8 billion cubic meters (7.1 million acre-feet) of water annually to springs and rivers (ANL 2003). Major areas of springs and seepages from the aquifer occur in the vicinity of the American Falls Reservoir (southwest of Pocatello), and the Thousand Springs area (near Twin Falls) between Milner Dam and King Hill (DOE 2002e).

Perched water occurs in the vadose zone at INL when sediments or dense basalt with low permeability impedes the downward flow of water to the aquifer (DOE 2002e). These perched water tables tend to slow the migration of pollutants that might otherwise reach the Snake River Plain Aquifer. Perched water tables have been detected beneath the INTEC and the RTC and are mainly attributed to disposal ponds (DOE 2002d).

INL has an extensive groundwater quality-monitoring network maintained by the U.S. Geological Survey. This network includes 178 observation or production wells in the Snake River Plain Aquifer and auger holes from which samples are collected and analyzed for selected organic, inorganic, and radioactive substances. INL also routinely monitors drinking water quality via 17 production wells and 10 distribution systems (DOE 2004f).

Historical waste disposal practices have produced localized plumes of radiochemical and chemical constituents in the Snake River Plain Aquifer at INL. Of principal concern over the years have been the movements of the tritium and strontium-90 plumes. The general extent of these plumes beneath INL is shown in **Figure 3–6**.

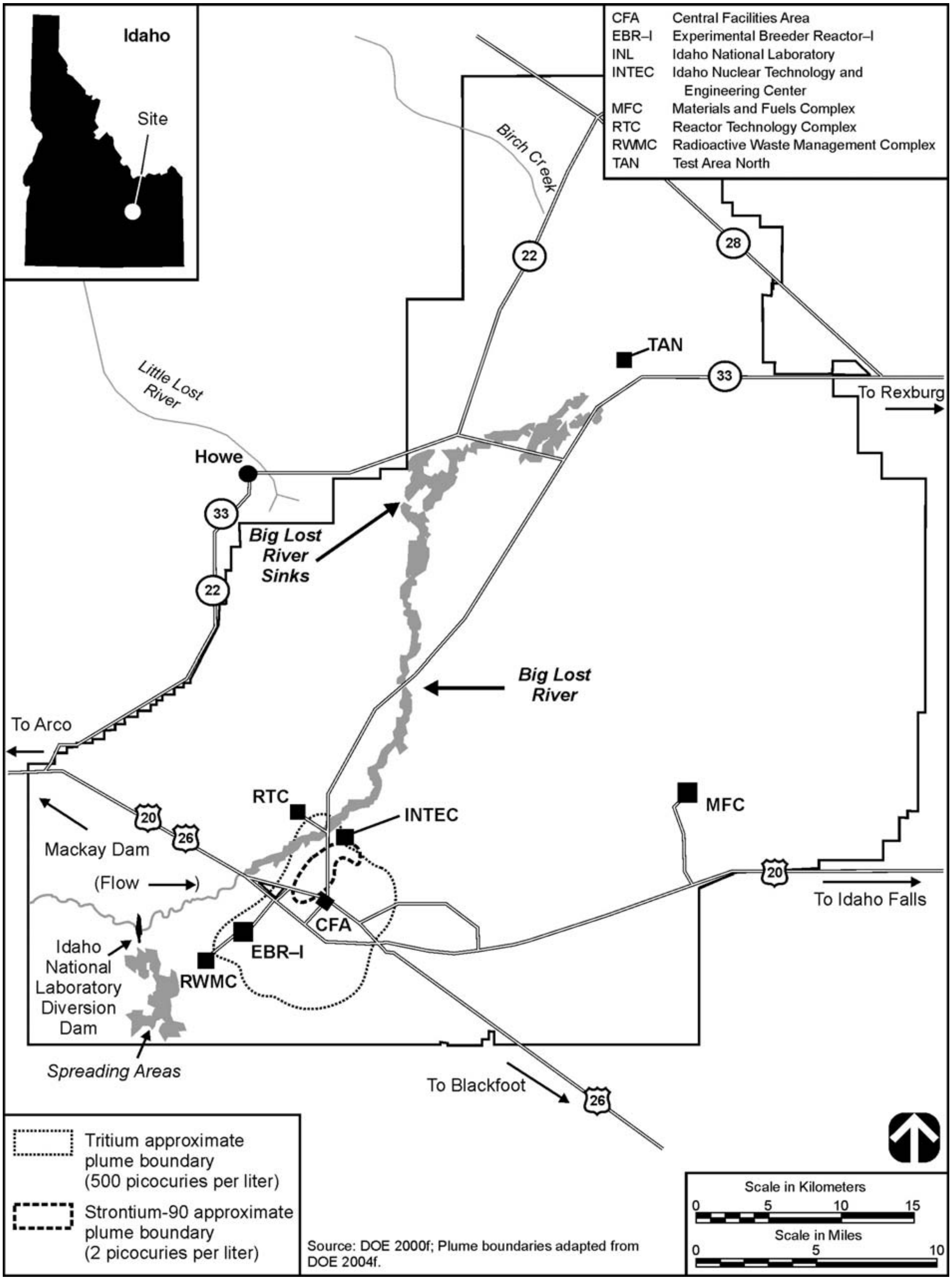

Figure 3–6 Extent of Tritium and Strontium-90 Plumes within the Snake River Plain Aquifer at the Idaho National Laboratory

The INTEC facility used direct injection as a disposal method until 1984. This wastewater contained high concentrations of both tritium and strontium-90. Injection at the INTEC was discontinued in 1984, and the injection well was sealed in 1990. When direct injection ceased, wastewater from INTEC was directed to a pair of shallow percolation ponds, where the water infiltrated into the subsurface. Disposal of low- and intermediate-level radioactive waste solutions to the percolation ponds ceased in 1993 with the installation of the Liquid Effluent Treatment and Disposal Facility. The RTC also discharged contaminated wastewater, but to a shallow percolation pond. The RTC pond was replaced in 1993 by a flexible plastic- (hypalon-) lined evaporative pond, which stopped the input of tritium to groundwater, and the new INTEC percolation ponds went into operation in August 2002 (DOE 2004f).

Concentrations of tritium in the area of aquifer contamination have continued to decrease. Two monitoring wells downgradient of RTC (Well 65) and INTEC (Well 77) have continually shown the highest tritium concentrations in the aquifer over time and are considered representative of maximum concentration trends in the rest of the aquifer. The average tritium concentration in Well 65 near RTC decreased from 13,000 picocuries per liter in 2002 to 9,400 picocuries per liter in 2003, and the average tritium concentration in Well 77 south of INTEC decreased from 13,800 picocuries per liter in 2002 to 13,400 picocuries per liter in 2003. The EPA MCL for tritium in drinking water is 20,000 picocuries per liter. The values in both Well 65 and Well 77 have remained below the EPA MCL of 20,000 picocuries per liter in recent years as a result of radioactive decay, a decrease in tritium disposal rates, and dilution within the Snake River Plain Aquifer (DOE 2004f).

Strontium-90 contamination originates from INTEC as a remnant of the earlier injection of wastewater. No strontium-90 groundwater contamination has been detected in the vicinity of RTC. All strontium-90 at RTC was disposed to infiltration ponds in contrast to the direct injection that occurred at INTEC. At RTC, strontium-90 is retained in surficial sedimentary deposits, interbeds, and in the perched groundwater zones. The area of the strontium-90 contamination from INTEC is approximately the same as it was in 1991. Concentrations of strontium-90 in wells have remained relatively constant since 1989. The concentration in Well 65 did increase between 2002 and 2003 from 1.5 to 2.55 picocuries per liter. Concentrations in Well 77 decreased from 2.0 picocuries per liter in 2002 to 1.8 picocuries per liter in 2003, as compared to the EPA MCL of 8 picocuries per liter. The upward trend in strontium-90 concentrations in the wells sampled over the last 10 years is thought to be due, in part, to a lack of recharge from the Big Lost River that would act to dilute the strontium-90. Also, an increase in the disposal of other chemicals into INTEC percolation ponds may have changed the affinity of strontium-90 on soil and rock surfaces, causing it to become more mobile (DOE 2004f).

From 1982 to 1985, INL used about 7.9 billion liters (2.1 billion gallons) per year from the Snake River Plain Aquifer, the only source of water at INL. This represents less than 0.3 percent of the groundwater withdrawn from that aquifer. Since 1950, DOE has held a Federal Reserved Water Right for the INL site that permits a pumping capacity of approximately 2.3 cubic meters (80 cubic feet) per second, with a maximum water consumption of 43 billion liters (11.4 billion gallons) per year. Total groundwater withdrawal at INL historically averages between 15 and 20 percent of that permitted amount (DOE 2002d). INL's production well system currently withdraws a total of about 4.5 billion liters (1.2 billion gallons) of water annually (see Section 3.2.2.4). Most of the groundwater withdrawn for use by INL facilities is returned to the subsurface via percolation ponds (DOE 2002d).

Materials and Fuels Complex

The depth of the water table of the Snake River Plain Aquifer beneath MFC ranges between 183 and 213 meters (600 to 700 feet), and groundwater flow is generally to the southwest across the site. All water used at MFC is groundwater from the underlying aquifer and is withdrawn via two production wells (see Section 3.2.2.4).

The MFC samples five wells (four monitoring and one production) twice a year for radionuclides, metals, total organic carbon, total organic halogens, and water quality parameters as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision (ROD) for Waste Area Group 9. Gross alpha, gross beta, and certain uranium isotopes were measured in groundwater during 2002. Uranium isotopes and gross alpha and gross beta activity have been measured in these wells in the past. The concentrations are consistent with concentrations attributable to natural sources of uranium- and thorium-series radionuclides, and the concentrations are the same for both upgradient and downgradient wells, implying a natural source for this radioactivity. Samples for gross alpha, gross beta, and tritium were also collected from the entrance to the drinking water distribution system in accordance with the Safe Drinking Water Act. Values for both gross alpha concentration and gross beta concentration were well below EPA drinking water MCLs. No detectable concentrations of tritium were reported. The annual nitrate sample results were below the respective MCLs (DOE 2004f).

Reactor Technology Complex

All water used at RTC is groundwater from the Snake River Plain Aquifer tapped by three deep wells (RTC-01, RTC-02, and RTC-03). The depth to the groundwater at the RTC is approximately 140 meters (460 feet). In general, RTC, encompassing the ATR complex, uses approximately 190 million liters (50 million gallons) of water per month. In 1998, groundwater withdrawals from these three wells for RTC uses totaled approximately 1.80 billion liters (475.5 million gallons). For 1999, total groundwater production was similar at about 1.78 billion liters (471 million gallons). Water use by individual facilities within RTC is not generally metered.

As part of routine potable production well system monitoring, water from the RTC distribution system was sampled and analyzed in 1998 for copper and nitrogen as nitrate, with concentrations measuring 1.2 and 1.1 milligrams per liter, respectively; results were below the established MCLs. In 1998, the RTC distribution system was also monitored for purgeable organics such as total trihalomethanes with a maximum detected concentration of 0.3 micrograms per liter, below the MCL of 100 micrograms per liter. The tritium concentration measured in the RTC potable water distribution system during 1998 was much lower than at INTEC and other sites with a maximum concentration of 30 picocuries per liter (MCL of 20,000 picocuries per liter). U.S. Geological Survey monitoring well data for tritium indicate that tritium concentrations continue to decrease, as observed near INTEC, with the concentration in Well 65 south of RTC decreasing from about 37,800 picocuries per liter in 1991 to 21,200 picocuries per liter in 1995 (DOE 2000f).

3.2.5 Air Quality and Noise

3.2.5.1 Air Quality

The climate at INL and the surrounding region is characterized as that of a semiarid steppe. The average annual temperature at INL is 5.6 degrees Celsius (°C) (42 degrees Fahrenheit [°F]); average monthly temperatures range from a minimum of -8.8 °C (16.1 °F) in January to a maximum of 20 °C (68 °F) in July. The average annual precipitation is 22 centimeters (8.7 inches). Prevailing winds at INL are southwest or northeast. The annual average wind speed is 3.4 meters per second (7.5 miles per hour).

Nonradiological Releases

INL is within the Eastern Idaho Intrastate Air Quality Control Region (#61). None of the areas within INL and its surrounding counties are designated as nonattainment areas with respect to the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants (40 CFR 81.313). The nearest nonattainment area for particulate matter is in Pocatello, about 80 kilometers (50 miles) to the south. Applicable NAAQS and Idaho State ambient air quality standards are presented in **Table 3–3**.

Table 3–3 Modeled Ambient Air Concentrations from Idaho National Laboratory Sources

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*INL Concentration* [b] *(micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	10,000 [c] 40,000 [c]	71 350
Lead	Quarterly	1.5	0.0081
Nitrogen dioxide	Annual	100 [c]	2.3
Ozone	8 hours 1 hour	157 235	(d) (d)
PM_{10}	Annual 24 hours	50 [c] 150 [c]	1.3 20
$PM_{2.5}$	Annual 24 hours	15 [e] 65 [e]	1.3 [f] 2.0 [f]
Sulfur dioxide	Annual 24 hours 3 hours	80 [c] 365 [c] 1,300 [c]	4.5 32 140

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] Maximum concentrations occur at receptors along public roads. Included existing INL facilities with actual 1997 INL emissions, plus reasonably foreseeable sources such as the Advanced Mixed Waste Treatment Project, CPP-606 steam production boilers, as accounted for in the Continued Operation Alternative cumulative concentrations presented in the *Idaho High Level Waste and Facilities Disposition Final EIS*.
[c] Federal and state standard.
[d] Not directly emitted or monitored by the site.
[e] Federal standard.
[f] Assumed to be the same as PM_{10} because there is no specific data for $PM_{2.5}$.
Note: NAAQS also include standards for lead. No sources of lead emissions have been identified for any alternative evaluated. Emissions of hazardous air pollutants not listed here have been identified at INL, but are not associated with any of the alternatives evaluated.
Sources: 40 CFR 50, DOE 2002e.

The primary source of air pollutants at INL is combustion of fuel oil for heating. Other emission sources include waste burning, industrial processes, stationary diesel engines, vehicles, and fugitive dust from waste burial and construction activities. Emissions for 2004 are presented in **Table 3–4**.

Table 3–4 Air Pollutant Emissions at Idaho National Laboratory in 2004 [a]

Pollutant	*Sources other than MFC*	*MFC*
Nitrogen dioxide	52.9	5.1
PM_{10}	2.9	0.3
Sulfur dioxide	7.2	1.1
Volatile organic compounds	1.3	0.3

MFC = Materials and Fuels Complex.
[a] Values in metric tons per year.
Note: To convert from metric tons to (short) tons, multiply by 1.1023.
Source: DOE 2005b.

Routine offsite monitoring for nonradiological air pollutants is generally only performed for particulate matter and nitrogen oxide. Monitoring for PM_{10} (particulate matter less than or equal to 10 microns in aerodynamic diameter) is performed at the site boundary and at communities beyond the boundary. In 2003, 60 samples were collected at Rexburg (about 60 kilometers [19.3 miles] east of the site). The PM_{10} concentrations at Rexburg for 2003 ranged from 0.42 to 153.9 micrograms per cubic meter. Sixty samples were collected at Blackfoot, with concentrations ranging from 1.3 to 173.7 micrograms per cubic meter. Fifty-nine samples were collected at Atomic City, with concentrations ranging from 0.7 to 73.0 micrograms per cubic meter. High 24-hour concentrations were attributed to high winds and exceptionally high airborne dust concentrations. All annual average concentrations at these monitors were below the ambient standard (DOE 2004f).

Monitoring for nitrogen dioxide is performed at two onsite locations. Quarterly mean concentrations at the Van Buran Boulevard location ranged from 2.9 to 3.9 parts per billion with an annual mean of 3.5 parts per billion. Quarterly means at the Experimental Field Station ranged from 7.4 to 10.7 parts per billion, with a mean concentration of 9.1 parts per billion based on two quarters of data. The mean concentrations were well below the ambient standard of 54 parts per billion.

Some monitoring data have also been collected by the National Park Service at the Craters of the Moon Wilderness Area. The monitoring program has shown no exceedances of the 1-hour ozone standard, low levels of sulfur dioxide (except for one exceedance of the 24-hour standard in 1985), and total suspended particulates within applicable standards. Note that the total suspended particulate standards have been replaced with PM_{10} standards.

Materials and Fuels Complex

The existing ambient air concentrations attributable to sources at INL, including MFC, are presented in Table 3–3. These concentrations are based on dispersion modeling at the INL site boundary and public roads. The estimated baseline was based on the modeled pollutant concentrations presented in the *Idaho High Level Waste and Facilities Disposition Final EIS* as a modified baseline for assessing cumulative impacts. Sources included existing INL facilities with actual 1997 INL emissions, plus reasonably foreseeable sources such as the Advanced Mixed Waste Treatment Project. In order to account for the CPP-606 steam production boilers that were accounted for only as elements of the waste processing alternatives, the Continued Operation Alternative cumulative concentrations are presented as the baseline (DOE 2002e). Concentrations shown in Table 3–3 represent a small percentage of the ambient air quality standards. Concentrations of any hazardous or toxic compounds would be well below regulatory levels.

Reactor Technology Complex

The ATR facility operates a diesel generator as a source of backup electrical power. This generator is a source of nonradioactive air emissions at ATR. Other diesel engines are also operated periodically and contribute to air emissions. The existing ambient air pollutant concentrations attributable to sources at ATR are presented in **Table 3–5**. These concentrations are estimated using SCREEN3 and are expected to overestimate the contribution to site boundary concentrations (DOE 2000f).

Because INL sources are limited and background concentrations of criteria pollutants are well below ambient standards, INL emissions should not result in air pollutant concentrations that violate the ambient air quality standards.

The nearest Prevention of Significant Deterioration Class I area to INL is the Craters of the Moon Wilderness Area in Idaho, 53 kilometers (33 miles) west-southwest from the center of the site. A Class I area is one in which very little increase in pollution is allowed due to the pristine nature of the area. There are no other Class I areas within 100 kilometers (62 miles) of INL. INL and its vicinity are classified as a Class II area in which more moderate increases in pollution are allowed.

Table 3–5 Comparison of Modeled Ambient Air Concentrations from the Advanced Test Reactor Sources with Most Stringent Applicable Standards or Guidelines

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline (micrograms per cubic meters)* [a]	*ATR Concentration (micrograms per cubic meters)*
Carbon monoxide	8 hours	10,000 [b]	33.6
	1 hour	40,000 [b]	48
Nitrogen dioxide	Annual	100 [b]	9.19
Ozone	1 hour	235 [c]	(d)
PM_{10}	Annual	50 [b]	4.72
	24 hours	150 [b]	37.7
Sulfur dioxide	Annual	80 [b]	1.50
	24 hours	365 [b]	12
	3 hours	1,300 [b]	26.9

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] Federal and state standard.
[c] Federal 8-hour standard is currently under litigation.
[d] Not directly emitted or monitored by the site.
Source: DOE 2000f.

EPA has established Prevention of Significant Deterioration increments for certain pollutants, such as sulfur dioxide, nitrogen dioxide, and particulate matter. The increments specify a maximum allowable increase above a certain baseline concentration for a given averaging period, and apply only to sources constructed or modified after a specified baseline date. These sources are known as increment-consuming sources. The baseline date is the date of submittal of the first application for a Prevention of Significant Deterioration permit in a given area.

Prevention of Significant Deterioration permits have been obtained for the coal-fired steam-generating facility next to INTEC and the Fuel Processing Facility, which is not expected to be operated. In addition to these facilities, INL has other increment-consuming sources onsite. Current amounts of Prevention of Significant Deterioration increment consumption in Class I and Class II areas by INL sources based on dispersion modeling analyses are specified in **Tables 3–6** and **3–7**, respectively (DOE 2002e).

Radiological Releases—Primary releases of radiological air pollutants at INL and localized releases at MFC are presented in **Table 3–8**. During 2003, an estimated 7,794 curies of radioactivity were released to the atmosphere from all INL sources. Of this, MFC released 539 curies and the RTC released 1,180 curies. Approximately 6,020 curies were released from the INTEC area of INL.

Routine monitoring for radiological air pollutants is performed at locations within, around, and distant from INL. The monitors are operated by the management and operations contractor and the Environmental Surveillance, Education and Research contractor. The management and operations contractor monitoring network includes 13 onsite monitors and 4 distant monitors. The Environmental Surveillance, Education and Research contractor monitoring network includes three onsite monitors, seven nearby monitors, and six distant monitors. The distant monitors are located as far away as Jackson, Wyoming, and Craters of the Moon National Monument. These monitoring programs and recent results are described in Chapter 4 of the *Idaho National Engineering and Environmental Laboratory Site Environmental Report Calendar Year 2003* (DOE 2004f).

Table 3–6 Prevention of Significant Deterioration Increment Consumption at Craters of the Moon Wilderness (Class I) Area by Existing (1996) and Projected Sources Subject to Prevention of Significant Deterioration Regulation

Pollutant	*Averaging Period*	*Allowable Prevention of Significant Deterioration Increment* [a] *(micrograms per cubic meter)*	*Amount of Prevention of Significant Deterioration Increment Consumed (micrograms per cubic meter)*
Nitrogen dioxide	Annual	2.5	0.27
Respirable particulates [b]	Annual 24 hours	4 8	0.032 0.61
Sulfur dioxide	Annual 24 hours 3 hours	2 5 25	0.23 3.4 11

[a] All increments specified are state of Idaho standards (ID DEQ 2004).
[b] Data on particulate size are not available for most sources. For purposes of comparison to the respirable particulate increments, it is conservatively assumed that all particulates emitted are of respirable size (i.e., 10 microns or less in diameter).
Note: Estimated increment consumption includes existing INL sources subject to Prevention of Significant Deterioration regulation and includes INTEC CPP-606 boilers. Increment consumption was modeled using the CALPUFF model in screening mode.
Source: DOE 2002e.

Table 3–7 Prevention of Significant Deterioration Increment Consumption at Class II Areas by Existing (1996) and Projected Sources Subject to Prevention of Significant Deterioration Regulation at Idaho National Laboratory

Pollutant	*Averaging Period*	*Allowable Prevention of Significant Deterioration Increment* [a] *(micrograms per cubic meter)*	*Amount of Prevention of Significant Deterioration Increment Consumed (micrograms per cubic meter)*
Nitrogen dioxide	Annual	25	8.8
Respirable particulates [b]	Annual 24 hours	17 30	0.53 10
Sulfur dioxide	Annual 24 hours 3 hours	20 91 512	3.6 27 120

[a] All increments specified are state of Idaho standards (ID DEQ 2004).
[b] Data on particulate size are not available for most sources. For purposes of comparison to the respirable particulate increments, it is conservatively assumed that all particulates emitted are of respirable size (i.e., 10 microns or less in diameter).
Note: Estimated increment consumption includes existing INL sources, subject to Prevention of Significant Deterioration regulations and includes INTEC CPP-606 boilers. Class II increment consumption was modeled using the ISCST3 dispersion model.
Source: DOE 2002e.

3.2.5.2 Noise

Major noise emission sources within INL include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most INL industrial facilities are far enough from the site boundary that noise levels from these sources are not measurable or are barely distinguishable from background levels at the boundary.

Table 3–8 Radiological Airborne Releases to the Environment at Idaho National Laboratory in 2003

Emission Type	*Radionuclide* [a]	*MFC (curies)*	*Other Facilities at INL* [b] *(curies)*	*Total (curies)*
Noble gases	Argon-41	1.41	819	820
	Krypton-85	534	5,306	5,840
	Krypton-85m	–	2.31	2.31
	Xenon-133	–	14.8	14.8
	Xenon-135	–	12.3	12.3
Airborne particulates	Sodium-24	–	0.0002	0.0002
	Chromium-51	–	0.02	0.02
	Rubidium-88	–	0.27	0.27
	Strontium-90 [c]	–	0.041	0.041
	Technetium-99m	–	0.0004	0.0004
	Antimony-125	–	3.57×10^{-5}	3.57×10^{-5}
	Cesium-137	–	0.28	0.28
	Cesium-138	–	0.009	0.009
	Uranium-234	–	5.94×10^{-6}	5.94×10^{-6}
	Plutonium-238	–	0.00018	0.00018
Tritium, carbon-14, and iodine isotopes	Tritium (Hydrogen-3)	3.29	1,100	1,103
	Carbon-14	–	1.23	1.23
	Iodine-129	–	0.072	0.072
	Iodine-131	–	0.21	0.21
	Iodine-133	–	2.77×10^{-4}	2.77×10^{-4}
	Iodine-135	–	4.83×10^{-4}	4.83×10^{-4}
Total releases		539	7,255	7,794

[a] The table includes all radionuclides with total releases greater than 10^{-7} curies. Values are not corrected for decay after release.
[b] Facilities include INTEC, RTC, and NRF.
[c] Parent-daughter equilibrium assumed.
Note: Dashed lines indicate virtually no releases.
Source: DOE 2004f.

Existing INL-related noises of public significance result from the transportation of people and materials to and from the site and in town facilities via buses, trucks, private vehicles, and freight trains. Noise measurements along U.S. Route 20, about 15 meters (50 feet) from the roadway, indicate that traffic sound levels range from 64 to 86 decibels A-weighted (dBA), and that the primary source is buses (71 to 80 dBA). While few people reside within 15 meters (50 feet) of the roadway, the results indicate that INL traffic noise might be objectionable to members of the public residing near principal highways or busy bus routes. Noise levels along these routes may have decreased somewhat due to reductions in employment and bus service at INL in the last few years. The acoustic environment along the INL site boundary in rural areas and at nearby areas away from traffic noise is typical of a rural location; the average day-night sound level is in the range of 35 to 50 dBA. Except for the prohibition of nuisance noise, neither the state of Idaho nor local governments have established any regulations that specify acceptable community noise levels applicable to INL. The EPA guidelines for environmental noise protection recommend an average day-night sound level limit of 55 dBA to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974). Land use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that annual day-night average sound levels less than 65 dBA are compatible with residential land uses (14 CFR Part 150). These guidelines further indicate that levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures. It is expected that, for most residences near INL, day-night average sound levels are compatible with residential land use, although noise levels may be higher than 65 dBA for some residences along major roadways.

Materials and Fuels Complex

No distinguishing noise characteristics at MFC have been identified. The MFC is 7 kilometers (4.3 miles) from the nearest site boundary, so the contribution from the area to noise levels at the site boundary is unmeasurable (DOE 2002d).

Reactor Technology Complex

No distinguishing noise characteristics at RTC have been identified. The RTC is far enough from the site boundary (11 kilometers [6.8 miles]) that noise levels at the site boundary from these sources are not measurable or are barely distinguishable from background levels (DOE 2000f).

3.2.6 Ecological Resources

3.2.6.1 Terrestrial Resources

INL lies in a cool desert ecosystem dominated by shrub-steppe communities. Most land within the site is relatively undisturbed and provides important habitat for species native to the region. Facilities and operating areas occupy 2 percent of INL; approximately 60 percent of the area around the periphery of the site is grazed by sheep and cattle. Although sagebrush communities occupy about 80 percent of INL, a total of 20 plant communities has been identified (**Figure 3–7**). These communities may be grouped into six types: shrub-steppe, juniper woodlands, native grasslands, modified ephemeral playas, lava, and wetland-like areas. In total, 398 plant taxa have been documented at INL (DOE 2002d and 2002e).

The interspersion of low sagebrush (*Artemisia arbuscula*) and big sagebrush (*Artemisia tridentate*) communities in the northern portion of INL and juniper communities in the northwestern and southeastern portions of the site are considered sensitive habitats. The former provide critical winter and spring range for greater sage grouse (*Centrocercus urophasianus)* and pronghorn (*Antilocapra americana*), while the latter are important to nesting raptors and songbirds. Riparian vegetation, primarily cottonwood (*Populus* sp.) and willow (*Salix* spp.) along the Big Lost River and Birch Creek provides nesting habitat for hawks, owls, and songbirds. Recently, approximately 29,950 hectares (74,000 acres) of open space in the north-central portion of the site was designated as the INL Sagebrush Steppe Ecosystem Reserve. The area represents some of the last sagebrush steppe habitat in the United States and provides habitat for numerous rare and sensitive plants and animals (DOE 2002d).

INL supports numerous animal species, including two amphibian, 11 reptile, 225 bird, and 44 mammal species. Common animals on the site include the short-horned lizard (*Phrynosoma douglassi*), gopher snake (*Pituophis melanoleucus*), sage sparrow (*Amphispiza belli*), Townsend's ground squirrel (*Spermophilus townsendii*), and black-tailed jackrabbit (*Lepus californicus*). Important game animals include the greater sage grouse, mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), and pronghorn. During some winters, 4,500 to 6,000 pronghorn, or about 30 percent of Idaho's total pronghorn population, may be found on INL. Pronghorn wintering areas are located in the northeastern portion of the site, in the area of the Big Lost River sinks, in the west-central portion of the site along the Big Lost River, and in the south-central portion of the site. Hunting elk and pronghorn is permitted only within 0.8 kilometers (0.5 miles) of the site boundary on INL lands adjacent to agricultural lands. Numerous raptors, such as the golden eagle (*Aquila chrysaetos*) and prairie falcon (*Falco mexicanus*), and carnivores, such as the coyote (*Canis latrans*) and mountain lion (*Felis concolor*), are also found on INL. A variety of migratory birds have been found at INL (DOE 2002d).

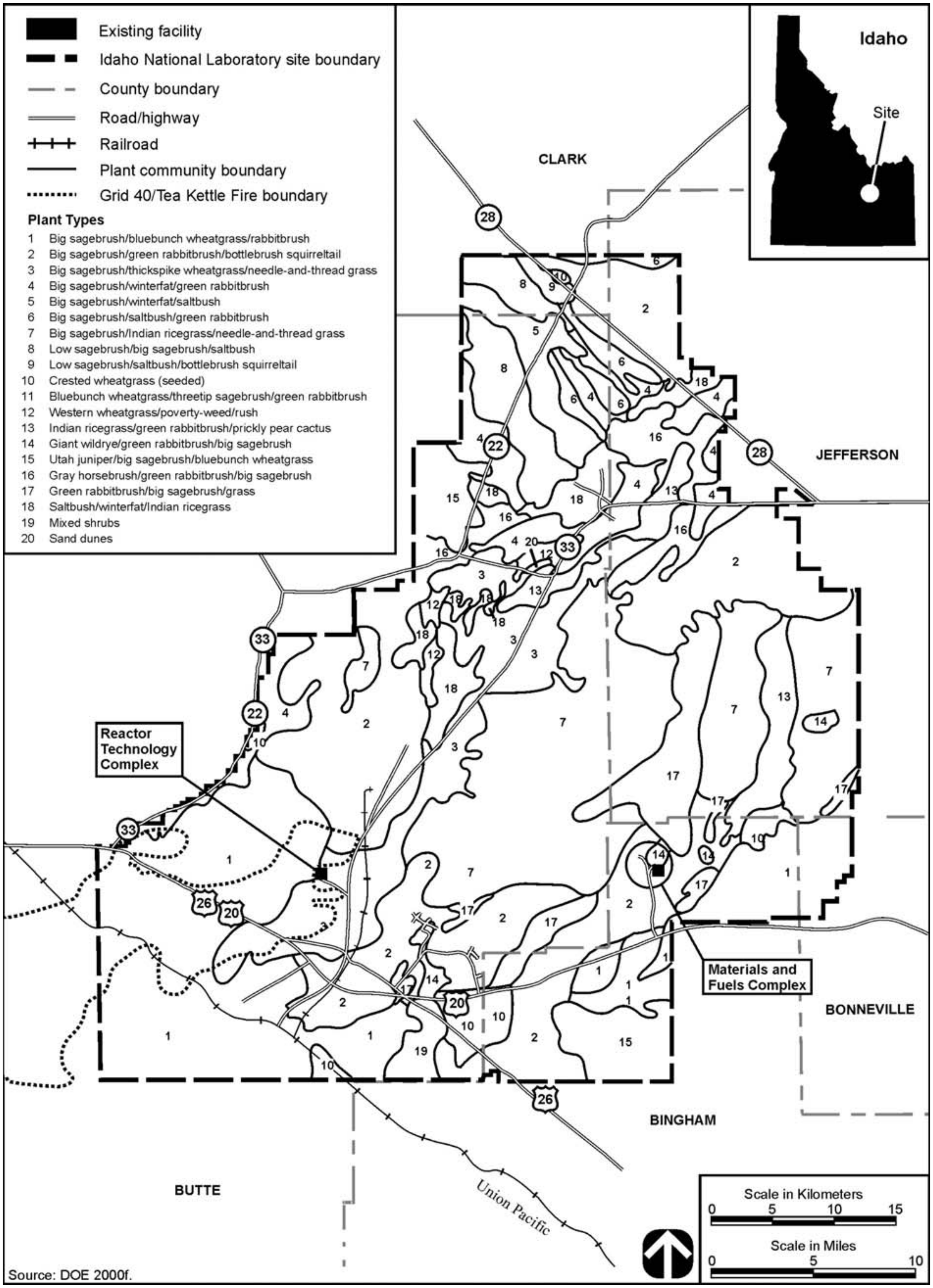

Figure 3–7 Vegetation Association at Idaho National Laboratory

Large wildfires in 1994, 1995, 1996, 1999, and 2000, played an important role in the ecology of INL. The most recent fires burned about 14,570 hectares (36,000 acres) in the summer and early fall of 2000 (DOE 2002e). The immediate effect of the fires on ecological resources at INL, aside from plants and animals that perished as a direct result of the fire, was the displacement of animals from their habitat. A longer-term concern is that non-native, invasive plant species may have a greater competitive advantage at the expense of native grasses and shrubs, especially where the ground was disturbed by fire fighting activities. Of particular concern is the loss of sagebrush, the dominant shrub of the shrub-steppe community. This plant is slow to regenerate since it must do so from seed, whereas many other plants regenerate from underground root systems. The slow recovery of sagebrush is likely to have a detrimental impact on greater sage grouse, which is dependent on this plant, particularly for critical winter habitat (DOE 2002d).

The MFC is located within one of several sagebrush communities found on INL (Figure 3–7). While sagebrush is present on undeveloped portions of the site, developed areas are nearly devoid of vegetation. Wildlife use of developed portions of the site is negligible; however, surrounding areas do provide natural habitat for a variety of animals. While elk and mule deer are the most important large mammals present in the area, many of the common species discussed above also would be expected. The MFC wastewater pond acts as an important source of water for wildlife found in the vicinity of the site (DOE 2002d).

The area in which the Radioisotope Power System (RPS) Nuclear Production Facility would be built is located immediately south of developed portions of the MFC. This site is on the edge of a burn area. It contains sagebrush with native grasses in the understory, as well as areas that have been replanted with crested wheatgrass (*Agropyron desertorum*). Wildlife present includes common species such as those noted above; few obligate sagebrush species are present (INL 2005c).

Three routes have been proposed to connect MFC with RTC (see Figure 2-12). While all three routes pass largely through sagebrush steppe habitat, both the T-3 Road and T-24 Road are quite rural with sagebrush and other vegetation not only growing to the edge of the road but between the tire tracks as well. Some portions of the T-3 Road in the vicinity of the Big Lost River and to the west of MFC have been burned in the past and are dominated by grasses. Portions of the East Power Line Road are also in areas that have previously burned and, in general, very little vegetation is growing on or directly adjacent to the road. Wildlife species including wintering elk, mule deer, and pronghorn, could occur along each of the routes (INL 2005c).

Vegetative communities in which big sagebrush is the dominant plant occur in the vicinity of RTC (Figure 3–7). Grasslands comprised primarily of crested wheatgrass also occur in the area. The RTC itself is a developed area with little or no native vegetation. Lawns and ornamental vegetation are used by a number of species such as songbirds, raptors, rabbits, and mule deer. Ponds in and around RTC are known to be frequented by waterfowl, shorebirds, swallows, passerines, and to a limited extent, by raptors such as the American kestrel (*Falco sparverius*), ferruginous hawk (*Buteo regalis*), and northern harrier (*Circus cyaneus*). Mammals have been observed at the disposal ponds despite perimeter fences, and amphibians have been reported at RTC Industrial Waste and Sewage Disposal Ponds (DOE 2000f).

3.2.6.2 Wetlands

Wetlands include "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3). National Wetland Inventory maps prepared by the U.S. Fish and Wildlife Service (USFWS) have been completed for most of INL. These maps indicate that the primary wetland areas are associated with the Big Lost River, the Big Lost River spreading areas, and the Big Lost River sinks, although smaller (less than about

0.4 hectares [1 acre]) isolated wetlands also occur intermittently. Wetlands associated with the Big Lost River are classified as riverine/intermittent, indicating a defined stream channel with flowing water during only part of the year. The only areas of jurisdictional wetland are the Big Lost River sinks (DOE 2002d). Wetland areas on INL are shown in Figure 3–5.

Wetland vegetation exists along the Big Lost River, which is located 18 kilometers (11 miles) west of MFC; however, this vegetation is in poor condition because of recent years of only intermittent flows. The Big Lost River spreading areas and Big Lost River sinks are seasonal wetlands and are located 34 kilometers (21 miles) west-southwest and 23 kilometers (14 miles) northwest of MFC, respectively. These areas can provide more than 809 hectares (2,000 acres) of wetland habitat during wet years. Within MFC itself, small areas of intermittent marsh occur along cooling tower blowdown ditches (DOE 2002d).

The proposed northern routing of the new road connecting MFC and RTC would pass through the Big Lost River which, while classified as riverine/intermittent (see above), is not jurisdictional (DOE 2002d). This portion of the route primarily contains sagebrush steppe habitat (see Figure 3–7). Neither the proposed T-24 Road nor the East Power Line Road routings would pass through the Big Lost River wetland. Nevertheless, a Preliminary Floodplain/Wetland Assessment has been prepared for this proposed activity in accordance with 10 CFR 1022 (see Appendix F).

The Big Lost River, Big Lost River spreading areas, and the Big Lost River sinks are about 2 kilometers (1.2 miles) southeast, 13 kilometers (8 miles) southwest, and 21 kilometers (13 miles) north-northeast of RTC. Wetlands do not occur in RTC (DOE 2000f).

3.2.6.3 Aquatic Resources

Aquatic habitat on INL is limited to the Big Lost River, Little Lost River, Birch Creek, and a number of liquid waste disposal ponds. All three streams are intermittent and drain into four sinks in the north-central part of the site. Six species of fish have been observed within water bodies located onsite. Species observed in the Big Lost River include brook trout (*Salvelinus fontinalis*), rainbow trout (*Salmo gaidneri*), mountain whitefish (*Prosopium williamsoni*), speckled dace (*Rhinichthys osculus*), shorthead sculpin (*Cottus confuses*), and kokanee salmon (*Oncorhynchus nerka*). The Little Lost River and Birch Creek, northwest and northeast of the RTC, respectively, enter the site only during periods of high flow. Surveys of fish in these surface water bodies have not been conducted. The liquid waste disposal ponds on INL, while considered aquatic habitat, do not support fish (DOE 2002d).

There is no natural aquatic habitat on or in the vicinity of MFC. The nearest such habitat is the Big Lost River, which is located 18 kilometers (11 miles) west of the site. The MFC waste disposal ponds do not contain any fish populations, but do provide habitat for a variety of aquatic invertebrates (DOE 2002d).

The proposed northern routing of the new road connecting MFC with RTC would pass across the Big Lost River (see Chapter 2, Figure 2–12 of this EIS); however, as noted above, the river is intermittent, only entering INL during periods of high flow. Neither the proposed T-24 Road nor the East Power Line Road routings would pass across the Big Lost River.

Although a number of disposal ponds occur in the vicinity of RTC, they do not support populations of fish. Aquatic invertebrates, however, are supported by habitat provided by the ponds. The Big Lost River is 2 kilometers (1.2 miles) southeast of RTC (DOE 2000f).

3.2.6.4 Threatened and Endangered Species

Twenty Federal- and State-listed threatened, endangered, and other special status species occur, or possibly occur, on INL (**Table 3–9**). Federally-listed plants and animals include 2 threatened, 1 candidate, and 10 species of concern. Idaho special status species include 1 threatened, 2 priority, 3 sensitive, and 2 special monitor. The bald eagle is listed by the USFWS as threatened (but is proposed for delisting); it is also listed as threatened by the state. The bald eagle has rarely been seen in the western and northern portions of the site. The gray wolf, listed by the USFWS as threatened, experimental population, has been sighted several times on INL (INL 2005c). No critical habitat for threatened or endangered species, as defined in the Endangered Species Act, exists on INL.

The MFC area was surveyed in 1996 for threatened, endangered, and special status species. The only listed species observed was the peregrine falcon and the loggerhead shrike. While no peregrine falcon nests were found near MFC, one peregrine falcon was observed perched on a power line 1.5 kilometers (0.9 miles) from the site. Since then, the peregrine falcon has been delisted. The gray wolf, pigmy rabbit, and Townsend's big-eared bat were not identified in the vicinity of MFC during the surveys. In addition, no Federally- or state-listed plants were found in the vicinity of the site (DOE 2002d).

Recent observations of the area within which the Plutonium-238 Facility would be located have verified that no unusual wildlife is present and that habitat for threatened and endangered species does not exist. However, a rattlesnake hibernacula is located about 0.62 kilometers (1 mile) south of the site. There is growing concern for rattlesnakes within the state in recent years and, in fact, all reptiles receive protection in Idaho. It is possible that rattlesnakes, including the Great Basin rattlesnake, could migrate as far north as the proposed Plutonium-238 Facility site once they leave the hibernaculum in the spring (INL 2005c).

Although formal surveys for sensitive species have not been conducted along any of the alternative routes of the proposed road connecting MFC and RTC, no Federal or State threatened or endangered species have been observed. However, other special status animals listed in Table 3–9 have been found within the vicinity of the T-3 Road and could occur along the other routes as well. The sage grouse and pygmy rabbit have been observed adjacent to the T-3 Road and a ferruginous hawk nest is located 30 meters (100 yards) from the road. A survey of each of the alternative routes would be necessary in order to document the presence of sensitive species (INL 2005c).

No threatened, endangered, or other special status plant or animal species have been recorded at or near RTC. However, the bald eagle, pygmy rabbit, and Townsend's big-eared bat potentially occur in the area (DOE 2000f).

3.2.7 Cultural Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. INL has a well-documented record of cultural and paleontological resources. Past studies, which covered 4 percent of the site, identified 1,506 cultural resource sites and isolated finds, including 688 prehistoric sites, 38 historic sites, 753 prehistoric isolates, and 27 historic isolates. As of January 1998, approximately 7 percent of INL had been surveyed, raising the number of potential archaeological sites to 1,839. Most surveys have been conducted near significant facility areas in conjunction with major modification, demolition, or abandonment of site facilities.

Table 3–9 Listed Threatened, Endangered, and Special Status Species of Idaho National Laboratory

Common Name	*Scientific Name*	*Status*	
		Federal	*State*
Plants			
Cushion milk vetch	*Astragalus gilviflorus*		State Priority 1
Inconspicuous phacelia	*Phacelia inconspicua*	Candidate	
Lemhi milkvetch	*Astragalus aquilonius*		State Sensitive
Painted milkvetch	*Astragalus ceramicus var. apus*	Special Concern	
Puzzling halimolobos	*Halimolobos perplexa*		State Monitor
Narrowleaf oxytheca	*Oxytheca dedroidea*		State Sensitive
Nipple coryphantha	*Escobaria missouriensis*		State Monitor
Spreading gilia	*Iponopsis polycladon*		State Priority 2
Winged-seed evening primrose	*Camissonia pterosperma*		State Sensitive
Reptiles			
Northern sagebrush lizard	*Sceloporus graciosus graciosus*	Special Concern	
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Ferruginous hawk	*Buteo regalis*	Special Concern	
Greater sage grouse	*Centrocercus urophasianus*	Special Concern	
Long-billed curlew	*Numemius americanus*	Special Concern	
Mammals			
Gray wolf	*Canis lupus*	Threatened, Experimental, nonessential population	
Long-eared myotis	*Myotis evotis*	Special Concern	
Merriam's shrew	*Sorex merriami*	Special Concern	
Pygmy rabbit	*Brachylagus idahoensis*	Special Concern	
Townsend's big-eared bat	*Dorynorhinus townsendii*	Special Concern	
Western small-footed myotis	*Myotis ciliolabrum*	Special Concern	

Federal:

Candidate: Taxa for which the USFWS has on file sufficient information on biological vulnerability and threats to support issuance of a proposed rule to list, but issuance of the proposed rule is precluded.

Special Concern: Species for which the USFWS is concerned about their population status and threats to their long-term viability. These species have no legal status under the Endangered Species Act.

Threatened: Taxa likely to be classified as Endangered within the foreseeable future throughout all or a significant portion of their range.

State:

State Sensitive: A taxon with small populations or localized distributions within Idaho that presently do not meet the criteria for classification as Priority 1 or 2, but whose populations and habitats may be jeopardized without active management or removal of threats.

State Monitor: Taxa that are common within a limited range or taxa that are uncommon, but have no identifiable threats.

State Priority 1: A taxon in danger of becoming extinct from Idaho in the foreseeable future if identifiable factors contributing to its decline continue to operate; these are taxa whose populations are present only at a critically low level or whose habitats have been degraded or depleted to a significant degree.

State Priority 2: A taxon likely to be classified as Priority 1 within the foreseeable future in Idaho, if factors contributing to its population decline or habitat degradation or loss continue.

Threatened: Any native species likely to be classified as Endangered within the foreseeable future throughout all or a significant portion of its Idaho range.

Sources: IFG 2005, INL 2005a and 2005c.

Cultural sites are often occupied continuously or intermittently over substantial timespans. For this reason, a single location may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented. However, the sum of these resources may be greater than the total number of sites reported due to such dual-use histories at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites, certain locations were used during both periods. DOE is currently evaluating the impacts to cultural resources from fire suppression activities during the Grid 40/Tea Kettle fire that burned across 19,830 hectares (49,000 acres) of the southwestern portion of the INL site on July 27 and 28, 2000.

3.2.7.1 Prehistoric Resources

Prehistoric resources identified at INL are generally reflective of American Indian hunting and gathering activities. A total of 688 prehistoric sites and 753 prehistoric isolates have been located. Most of the prehistoric sites are lithic scatters or locations (DOE 2002d). Resources appear to be concentrated along the Big Lost River and Birch Creek, atop buttes, and within craters or caves. They include residential bases, campsites, caves, hunting blinds, rock alignments, and limited-activity locations such as lithic and ceramic scatters, hearths, and concentrations of fire-affected rock. Although the northernmost route between MFC and RTC along the existing T-3 Road (the Old Stagecoach/Jeep Trail) has never been surveyed for archaeological resources, predictive modeling indicates the probable density of prehistoric archaeological sites in the area would be "medium to medium-high." A 1985 archaeological survey of the north side of T-24 Road documented 23 prehistoric archaeological sites. Although numerous prehistoric archaeological sites have been discovered along the East Power Line Road, past consultations with the State Historic Preservation Officer have determined that activities along portions of this road would have no adverse effect on significant archaeological materials (INL 2005c). Most known sites at INL have not been formally evaluated for nomination to the National Register of Historic Places, but are considered to be potentially eligible. Given the rather high density of prehistoric sites at INL, additional sites are likely to be identified as surveys continue.

Materials and Fuels Complex

The most recent cultural resource survey conducted near MFC took place in 1996 and covered an area to the south of the site that had been burned over by a wildfire and was proposed for revegetation. A total of 12 isolated finds and 2 archaeological sites were located. Isolated finds included items such as pieces of Shoshone brownware pottery and projectile points. The archaeological sites included projectile points, scrapers, and volcanic glass flakes. Areas within the fenced portion of the MFC site are highly disturbed and are not likely to yield significant archaeological material (DOE 2002d).

Reactor Technology Complex

A variety of archaeological survey projects have been completed in RTC. During a 1984 examination of a 100-meter-wide (328-foot-wide) corridor surrounding the fenced RTC perimeter, no prehistoric resources were identified. It is also unlikely that undisturbed prehistoric resources are present within the fenced perimeter of the facility, although no specific archaeological surveys have been conducted inside the fence. Although no prehistoric sites are known to occur around the periphery of RTC, significant sites have been documented in the vicinity, including a multi-component archaeological site, and smaller American Indian campsites (DOE 2000f).

3.2.7.2 Historic Resources

Thirty-eight historic sites and 27 historic isolates have been identified at the INL site. These resources are representative of European-American activities, including fur trapping and trading, immigration, transportation, mining, agriculture, and homesteading, as well as more recent military and scientific/engineering research and development activities. Examples of historic resources include

Goodale's Cutoff (a spur of the Oregon Trail), remnants of homesteads and ranches, irrigation canals, and a variety of structures from the World War II era.

Historic Land Status and Use Records from the early 1990s refer to the T-3 Road as the "Lost River Road to Idaho Falls." These records also indicate that at least one pioneer homestead is located on INL lands along this corridor. T-24 Road is not a historic trail and was probably constructed sometime after 1950 (INL 2005c).

The EBR-I, the first reactor to achieve a self-sustaining chain reaction using plutonium instead of uranium as the principal fuel component, is listed on the National Register of Historic Places and is designated as a National Historic Landmark. Many other INL structures built between 1949 and 1974 are considered eligible for the National Register because of their exceptional scientific and engineering significance, and their major role in the development of nuclear science and engineering since World War II. Additional historic sites are likely to exist in unsurveyed portions of INL (DOE 2002d).

Materials and Fuels Complex

A number of recent items, including farm implements, a belt buckle, broken glass, and a large scattering of cans, have been found in the vicinity of MFC. The EBR-II has been designated as an American Nuclear Society Historical Landmark (DOE 2002d).

Reactor Technology Complex

All three of the major reactors within RTC (the Materials Test Reactor, the Engineering Test Reactor, and ATR), along with numerous support facilities, are considered eligible for listing on the National Register of Historic Places. As a result of an historic building inventory conducted in 1997, 59 RTC buildings are considered to be eligible for the National Register (DOE 2000f).

3.2.7.3 Traditional Cultural Properties

Traditional cultural properties at INL are associated with the two groups of nomadic hunters and gatherers that used the region at the time of European-American contact: the Shoshone and Bannock. Both of these groups used the area that now encompasses INL as they harvested plant and animal resources and obsidian from Big Southern Butte and Howe Point. Because the INL site is considered part of the Shoshone-Bannock Tribes' ancestral homeland, it contains many localities that are important for traditional, cultural, educational, and religious reasons. This includes not only prehistoric archaeological sites that are important in the context of a religious or cultural heritage, but also features of the natural landscape and air, plant, water, and animal resources that have special significance (DOE 2002d). "Aviators' Cave," an important archaeological site that is a sacred area to the Shoshone-Bannock Tribes, is accessed from the T-3 Road and is located only a short distance from the existing road (INL 2005c).

Over the past two decades, efforts have been underway to assemble complete inventories of cultural resources in the vicinity of major operating facilities at INL. Prehistoric American Indian resources have been found in the vicinity of MFC (DOE 2002d). A variety of survey projects have been completed near RTC, including a 1984 examination of a 100-meters-wide (328-foot-wide) corridor surrounding the fenced perimeter of the site. No American Indian resources were identified within the surveyed area, and it is unlikely that undisturbed American Indian resources are present within the fenced perimeter of RTC, although no specific surveys have been conducted. Cultural resource surveys in the vicinity of RTC have identified small American Indian campsites, and an area that may be of traditional and cultural importance to the Shoshone-Bannock Tribes (DOE 2000f).

The region encompassing INL also has abundant and varied paleontological resources, including plant, vertebrate, and invertebrate remains in soils, lake and river sediments, and organic materials found in caves and archaeological sites. Vertebrate fossils recovered from the Big Lost River floodplain consist of isolated bones and teeth from large mammals of the Pleistocene or Ice Age. These fossils were discovered during excavations and well drilling operations. Fossils have been recorded in the vicinity of NRF. Occasional skeletal elements of fossil mammoth, horse, and camel have been retrieved from the Big Lost River diversion dam and Radioactive Waste Management Complex on the southwestern side of the INL site, and from river and alluvial fan gravels and Lake Terreton sediments near Test Area North. A mammoth tooth dating from the Pleistocene was recovered from RTC. In total, 24 paleontological localities have been identified on INL. Paleontological resources were not found in the immediate vicinity of MFC during a recent archaeological survey (DOE 2002d).

3.2.8 Socioeconomics

Statistics for population, housing, and local transportation are presented for the region of influence, a four-county area in Idaho in which 94.4 percent of all INL employees reside (**Table 3–10**). In 2001, INL employed an average of 8,100 persons (DOE 2002e).

Table 3–10 Distribution of Employees by Place of Residence in the Idaho National Laboratory Region of Influence in 1997

County	*Number of Employees*	*Total Site Employment (percent)*
Bonneville	5,553	67.0
Bingham	1,077	13.0
Bannock	615	7.4
Jefferson	583	7.0
Region of influence total	7,828	94.4

Source: DOE 2000f.

3.2.8.1 Regional Economic Characteristics

Between 2000 and 2003, the civilian labor force in the region of influence increased 4.4 percent, to the 2003 level of 123,383 (ID Commerce and Labor 2005). In 2003, the annual unemployment average in the four-county area was 4.1 percent, which was slightly less than the annual unemployment average for Idaho (5.4 percent) (ID DOL 2004).

In 2003, trade, utilities, and transportation represented the largest sector of employment in the region of influence (22.1 percent). This was followed by government (19.9 percent), and professional and business services (12.7 percent). The totals for these employment sectors in Idaho were 19.9 percent, 18.6 percent, and 4.3 percent, respectively (ID Commerce and Labor 2005).

3.2.8.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 3–11**. The 2000 population in the four-county area was 218,977 people. The predominant population in the region of influence is white; 7.6 percent of the population has a Hispanic or Latino ethnic background.

Table 3–11 Demographic Profile of the Population in the Idaho National Laboratory Region of Influence

	Bannock County	*Bingham County*	*Bonneville County*	*Jefferson County*	*Region of Influence*
Population					
2000 Population	75,565	41,735	82,522	19,155	218,977
1990 Population	66,026	37,583	72,207	16,543	192,359
Percent change from 1990 to 2000	14.4	11.0	14.3	15.8	13.8
Race (2000) (percent of total population)					
White	91.3	82.4	92.8	90.9	90.1
Black or African American	0.6	0.2	0.5	0.3	0.4
American Indian and Alaska Native	2.9	6.7	0.6	0.5	2.6
Asian	1.0	0.6	0.8	0.2	0.8
Native Hawaiian and other Pacific Islander	0.2	0.0	0.1	0.1	0.1
Some other race	2.1	8.0	3.7	6.8	4.2
Two or more races	2.0	2.1	1.5	1.3	1.8
Percent minority	10.5	21.4	9.8	11.5	12.4
Ethnicity (2000)					
Hispanic or Latino	3,540	5,550	5,703	1,907	16,700
Percent of total population	4.7	13.3	6.9	10.0	7.6

Source: DOC 2005.

Income information for the INL region of influence is included in **Table 3–12**. Bonneville County has the highest median household income of the four counties in the region of influence ($41,805) and the lowest percent of persons (10.1 percent) living below the poverty line. Bingham County has the lowest median household income ($36,423) but Bannock County has the largest number of individuals (13.9 percent) living below the poverty line. The average median household income in the four counties is comparable to the median household income of the state of Idaho ($37,572) during this same time period.

Table 3–12 Income Information for the Idaho National Laboratory Region of Influence

	Bannock	*Bingham*	*Bonneville*	*Jefferson*	*Idaho*
Median household income 2000 (dollars)	36,683	36,423	41,805	37,737	37,572
Percent of persons below poverty line (2000)	13.9	12.4	10.1	10.4	11.8

Source: DOC 2005.

3.2.8.3 Housing

Table 3–13 lists the total number of occupied housing units and vacancy rates in the region of influence. In 2000, of the total of 80,176 housing units in the region of influence, 93.7 percent were occupied and 6.3 percent were vacant. Bingham County had the greatest vacancy rate of the four counties at 6.9 percent and Bonneville County had the smallest vacancy rate at 5.7 percent. Home values were the most expensive in Bonneville County with a median housing value of $93,500 and the least expensive in Bingham County at $84,400.

Table 3–13 Housing in the Idaho National Laboratory Region of Influence

	Bannock	*Bingham*	*Bonneville*	*Jefferson*	*Region of Influence*
Housing (2000)					
Total units	29,102	14,303	30,484	6,287	80,176
Occupied housing units	27,192	13,317	28,753	5,901	75,163
Vacant units	1,910	986	1,731	386	5,013
Vacancy Rate (percent)	6.6	6.9	5.7	6.1	6.3
Median value (dollars)	90,000	84,400	93,500	91,900	89,950

Source: DOC 2005.

3.2.8.4 Local Transportation

U.S. Highways 20 and 26 are the main access routes to the southern portion of the INL site, and State Routes 22 and 33 provide access to the northern INL facilities (Figure 3–2).

DOE buses provide transportation between INL facilities and Idaho Falls for DOE and contractor personnel. The major railroad in the area is the Union Pacific Railroad. The railroad's Blackfoot-to-Arco Branch provides rail service to the southern portion of the INL site. A DOE-owned spur connects the Union Pacific Railroad to INL by a junction at Scoville Siding. There are no navigable waterways within the area capable of accommodating waterborne transportation of material shipments to INL. Fanning Field in Idaho Falls, ID, and Pocatello Municipal Airport in Pocatello, ID, provide jet air passenger and cargo service for both national and local carriers. Numerous smaller private airports are located throughout the region of influence.

3.2.9 Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

3.2.9.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of INL are shown in **Table 3–14**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to INL operations.

Releases of radionuclides to the environment from INL operations provide another source of radiation exposure to individuals in the vicinity of INL. Types and quantities of radionuclides released from INL operations in 2003 are listed in the *Idaho National Engineering and Environmental Laboratory Site Environmental Report for Calendar Year 2003* (DOE 2004f). The releases are summarized in Section 3.2.5.1 of this EIS. The doses to the public resulting from these releases are presented in **Table 3–15.** These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those of background radiation.

Table 3–14 Sources of Radiation Exposure to Individuals in the Idaho National Laboratory Vicinity Unrelated to Idaho National Laboratory Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
External (terrestrial and cosmic) [a]	123
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	Less than 1
Air travel	1
Consumer and industrial products	10
Total	428

[a] DOE 2004f.
[b] NCRP 1987.
[c] An average for the United States.

Table 3–15 Radiation Doses to the Public from Normal Idaho National Laboratory Operations in 2003 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard [a]*	*Actual*	*Standard [a]*	*Actual*
Maximally exposed offsite individual (millirem)	10	0.035	4	0	100	0.035
Population within 80 kilometers (50 miles) (person-rem) [b]	None	0.022	None	0	100	0.022
Average individual within 80 kilometers (50 miles) (millirem) [c]	None	0.00008	None	0	None	0.00008

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem per year limit from airborne emissions is required by the Clean Air Act (40 CFR 61), and the 4-millirem per year limit is required by the Safe Drinking Water Act (40 CFR 141). The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, *Radiation Protection of the Public and Environment; Proposed Rule,* as published in 58 *Federal Register* (FR) 16268. If the potential total dose exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.
[b] Based on an estimated population of 276,979 in 2003.
[c] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.
Source: DOE 2004f.

Using a risk estimator of 6.0×10^{-4} latent cancer fatalities (LCF) per rem (see Appendix C of this EIS), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from INL operations in 2003 is estimated to be 2.1×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of INL operations is 1 in 48 million (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

According to the same risk estimator, 1.3×10^{-5} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of INL from normal operations in 2003. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 2003 from all causes in the population living within 80 kilometers (50 miles) of INL would be 554. This expected number of fatal cancers is much higher than the fatal cancers estimated from INL operations in 2003.

INL workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at INL from operations in 2003 are presented in **Table 3–16**. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of 6.0×10^{-4} LCF per person-rem among workers (see Appendix C of this EIS), the number of projected fatal cancers among INL workers from normal operations in 2003 is 0.038.

Table 3–16 Radiation Doses to Workers from Normal Idaho National Laboratory Operations in 2003 (total effective dose equivalent)

Occupational Personnel	***Onsite Releases and Direct Radiation***	
	Standard [a]	***Actual***
Average radiation worker (millirem)	None [b]	56 [c]
Total workers [c] (person-rem)	None	64 [c]

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999f); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] No standard is specified for an average radiation worker; however, the maximum dose that this worker may receive is limited to that given in footnote "a."
[c] There were 1,141 workers with measurable doses in 2003.
Source: DOE 2003e.

3.2.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at INL via inhalation of air containing hazardous chemicals released to the atmosphere by INL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 3.2.5.1. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations.

Chemical exposure pathways to INL workers during normal operations may include inhaling the workplace atmosphere, drinking INL potable water, and possible other contacts with hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. INL workers are also protected by adherence to Occupational Safety and Health Administration and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals.

Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at INL are substantially better than required by standards.

3.2.9.3 Health Effect Studies

Epidemiological studies were conducted on communities surrounding INL to determine whether there are excess cancers in the general population. Two of these are described in more detail in Appendix M.4.4 of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996d). No excess cancer mortality was reported, and although excess cancer incidence was observed, no association with INL was established. A study by the state of Idaho completed in June 1996 found excess brain cancer incidence in the six counties surrounding INL, but a follow-up survey concluded that there was nothing that clearly linked all these cases to one another or any one thing (DOE 1996d).

Researchers from the Boston University School of Public Health, in cooperation with the National Institute of Occupational Safety and Health, are investigating the effects of workforce restructuring (downsizing) in the nuclear weapons industry. The health of displaced workers will be studied. Under a National Institute of Occupational Safety and Health cooperative agreement, the epidemiological evaluation of childhood leukemia and paternal exposure to ionizing radiation included the INL site. This study found no evidence of a link between brain cancer or leukemia and paternal employment at INL (DOE 2002d). Another study begun in October 1997, *Medical Surveillance for Former Workers at INL*, is being carried out by a group of investigators consisting of the Oil, Chemical, and Atomic Workers International Union; Mount Sinai School of Medicine; the University of Massachusetts at Lowell; and Alice Hamilton College. A mortality study of the workforce at INL was conducted by the National Institute of Occupational Safety and Health. DOE has implemented an epidemiological surveillance program to monitor the health of current INL workers. A discussion of this program is given in Appendix M.4.4 of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996d).

3.2.9.4 Accident History

Since the early 1950s, there have been eight criticality accidents at INL (DOE 2002d). Some accidents resulted from intentional experiments, but the power excursion was significantly larger than expected. The accidents occurred during processing, control rod maintenance, critical experiment setups, and intentional destructive power excursions. These accidents resulted in various levels of radiation exposure to the involved workers and in no damage to, small damage to, or total loss of the equipment. The exposure to the public from these accidents was minimal.

DOE conducted a study, the *Idaho National Engineering Laboratory Historical Dose Evaluation*, to estimate the potential offsite radiation doses for the entire operating history of INL (DOE 1996d). Releases resulted from a variety of tests and experiments as well as a few accidents at INL. The study concluded that these releases contributed to the total radiation dose during test programs of the 1950s and early 1960s. The frequencies and sizes of releases have declined since that time. During more than the last decade of operations at INL facilities, there have been no serious unplanned or accidental releases of radioactivity or other hazardous substances.

3.2.9.5 Emergency Preparedness and Security

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program was developed and is maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, training, preparedness, and response.

Government agencies whose plans are interrelated with the *INL Emergency Plan for Action* include the state of Idaho; Bingham, Bonneville, Butte, Clark, and Jefferson Counties; the Bureau of Indian Affairs; and the Fort Hall Indian Reservation. INL contractors are responsible for responding to emergencies at their facilities. Specifically, the Emergency Action Director is responsible for recognition, classification, notification, and protective action recommendations. At INL, emergency preparedness resources include fire protection from onsite and offsite locations and radiological and hazardous chemical material response. Emergency response facilities include an emergency control center at each facility, at the INL Warning Communication Center, and at the INL Site Emergency Operations Center. Seven INL medical facilities are available to provide routine and emergency service. In addition, DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at the Hanford Site in May 1997.

3.2.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. Minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income.

Figure 3–8 shows MFC and region of potential radiological impacts. As shown in the figure, the region includes Idaho Falls, portions of the Fort Hall Indian Reservation, and Pocatello.

Fourteen counties in Idaho are included or partially included in the potentially affected area: Bannock, Bingham, Blaine, Bonneville, Butte, Caribou, Clark, Custer, Fremont, Jefferson, Lemhi, Madison, Minidoka, and Power (see **Figure 3–9**). **Table 3–17** provides the total minority composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, approximately 13 percent of the county residents identified themselves as members of a minority group. Hispanics and American Indians or Alaska Natives comprised more than 80 percent of the minority population.

The percentage of population for whom poverty status was determined in potentially affected counties in 2000 was approximately 14 percent. In 2000, nearly 12 percent of the total population of Idaho reported incomes less than the poverty threshold. In terms of percentages, minority populations and low-income resident populations in 2000 in potentially impacted counties were slightly higher than the state percentage.

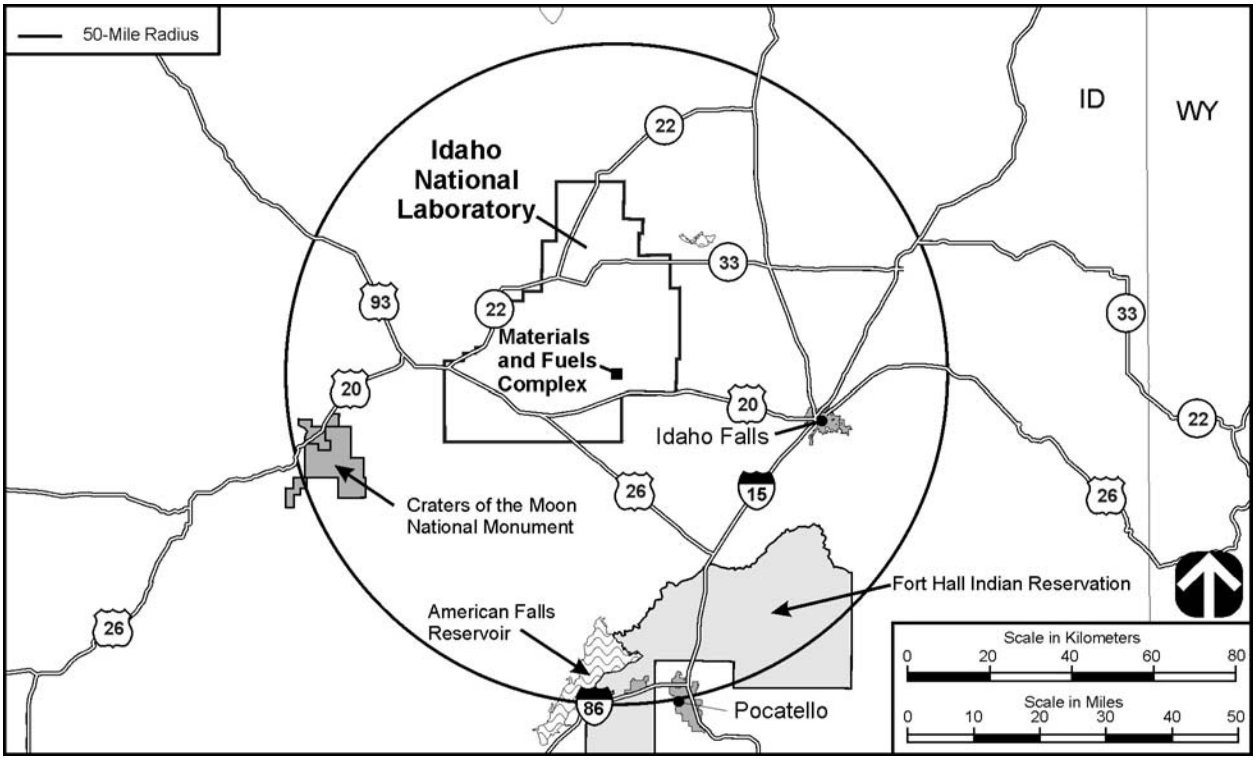

Figure 3–8 Location of the Materials and Fuels Complex and the Fort Hall Indian Reservation

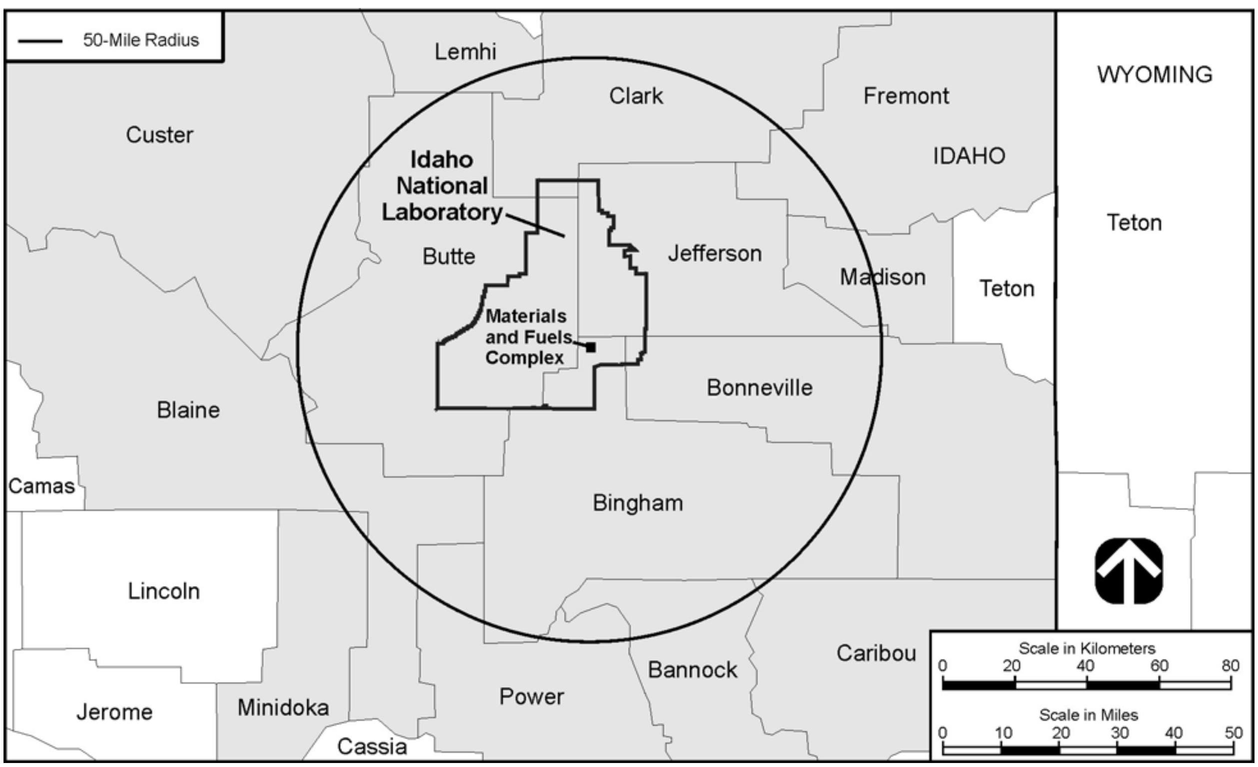

Figure 3–9 Potentially Affected Counties near the Materials and Fuels Complex

Table 3–17 Populations in Potentially Affected Counties Surrounding the Materials and Fuels Complex in 2000

Population Group	*Population*	*Percentage of Total*
Minority	41,447	12.6
Hispanic	28,828	8.8
Black or African American	1,085	0.3
American Indian and Alaska Native	5,732	1.7
Asian	1,984	0.6
Native Hawaiian and Pacific Islander	257	0.1
Two or more races	3,417	1.0
Some other race	174	0.1
White	286,862	87.4
Total	328,339	100.0

Source: DOC 2005.

3.2.11 Waste Management and Pollution Prevention

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies, and in compliance with all applicable Federal and State statutes and DOE Orders.

3.2.11.1 Waste Inventories and Activities

INL manages the following types of waste: high-level radioactive, transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Because there is no high-level waste associated with the Proposed Action, this waste type is not discussed in this EIS. Waste generation rates and the inventory of stored waste from activities at INL are provided in **Table 3–18**. INL waste management capabilities are summarized in **Table 3–19**.

Table 3–18 2004 Waste Generation Rates and Inventories at Idaho National Laboratory

Waste Type	*Generation Rate (cubic meters in 2004)* [a]	*Inventory as of 12/31/04 (cubic meters)*
Transuranic	10 [b]	61,553 [b,c]
Low-level radioactive	9,846 [d]	704 [d]
Mixed low-level radioactive	1,373 [d]	899 [d]
Hazardous	422 [d]	163 [d]
Nonhazardous		
Liquid	3,333,900 [e]	Not applicable [f]
Solid	49,430 [d]	Not applicable [f]

[a] Calendar Year 2004 (1/1/04 to 12/31/04).
[b] Transuranic includes alpha low-level.
[c] Transuranic inventory based on 65,000 cubic meters reduced by 3,447 cubic meters shipped to WIPP to date. Volume does not include the buried transuranic waste, which is estimated at 62,000 cubic meters.
[d] Excludes CERCLA waste generation, which is nonrecurring.
[e] Includes both industrial and sanitary waste volumes.
[f] Generally, nonhazardous wastes are not held in long term storage.
Note: To convert from cubic meters to cubic yards, multiply by 1.3079.
Source: INL 2005c.

Table 3–19 Waste Management Facilities at Idaho National Laboratory

Facility Name/Description	Facility Number	Capacity	Status	Applicable Waste Types			
				TRU	LLW	MLLW	HAZ
Treatment Facility (cubic meters per day except as otherwise specified)							
NWCF Debris Treatment Process	CPP-659	160	Permitted			X	X
NWCF HEPA Filter Leach System	CPP-659	0.34	Permitted			X	X
Contaminated Equipment Storage Building	MFC-794	1.7	Permitted	X		X	X
HFEF	MFC-785	1.7	Permitted	X		X	X
Sodium Components Maintenance Shop	MFC-793	7.6	Permitted			X	X
Transient Reactor Test Facility	MFC-720	1.7	Permitted	X		X	X
Advance Mixed Waste Treatment Project Waste Storage Facility	RWMC	80	Permitted	X		X	
Advance Mixed Waste Treatment Project Waste Storage Facility	WMF-676	130	Permitted	X		X	
Remote Treatment Project	MFC	(a)	Planned	X	X	X	
Storage Facilities (capacity in cubic meters)							
NWCF Storage	CPP-659	2242	Permitted			X	X
Radioactive Mixed Waste Staging Facility	CPP-1617	8494	Permitted			X	X
Hazardous Chemical and Radioactive Waste Storage Facility	CPP-1619	52	Permitted			X	X
RWMC Waste Storage Facility	WMF-628	8176	Permitted	X		X	
SWEPP Storage Area	WMF-610	107	Permitted	X	X	X	
Contaminated Equipment Storage Building (cubic meters per day)	MFC-794	57	Permitted	X		X	X
HFEF	MFC-785	41	Permitted	X		X	X
Radioactive Scrap and Waste Facility	MFC-771	201	Permitted	X	X	X	X
Sodium Components Maintenance Shop	MFC-793	120	Permitted			X	X
Sodium Storage Building	MFC-703	182	Permitted			X	X
Transient Reactor Test Facility	MFC-720	27	Permitted	X		X	X
TRU Storage Pad (TSA)-Pad 1/Pad R (TSA-1/TSA-R)	RWMC	76600	Interim Status	X		X	
TSA-Retrieval Enclosure Retrieval Modification Facility	RWMC	93409 (includes TSA-1 and TSA-R volume)	Interim Status	X		X	
Advance Mixed Waste Treatment Project Waste Storage Facility	RWMC	72598	Permitted	X		X	

TRU = transuranic, LLW = low-level radioactive, MLLW = mixed low-level radioactive, HAZ = hazardous, NWCF = New Waste Calcining Facility, HEPA = high-efficiency particulate air filter, HFEF = Hot Fuel Examination Facility, RWMC = Radioactive Waste Management Complex, SWEPP = Stored Waste Examination Pilot Plant, TSA = Transuranic Storage Area.

[a] Facility in planning stage. Capacity will be determined after design is completed.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079.

Source: INL 2005c.

3.2.11.2 Transuranic Waste

Transuranic waste generated since 1972 is segregated into contact-handled and remotely handled categories and stored at the Radioactive Waste Management Complex in a form designed for eventual retrieval. Some transuranic waste is also stored at the Radioactive Scrap and Waste Facility at MFC. Virtually no transuranic waste is generated at INL. Most of the transuranic waste in storage was received from the Rocky Flats Environmental Technology Site. Transuranic waste is currently being stored, pending shipment to the Waste Isolation Pilot Plant (WIPP) in New Mexico. Transuranic waste will be treated to meet WIPP waste acceptance criteria, packaged in accordance with DOE and U.S. Department of Transportation (DOT) requirements, and transported to WIPP for disposal (DOE 1996d). The first shipment of transuranic waste from INL was received at WIPP on April 28, 1999 (DOE 2000f).

3.2.11.3 Low-Level Radioactive Waste

Liquid low-level radioactive wastes are discharged to the two double-lined ponds at RTC for evaporation. The two test reactor evaporation ponds have a capacity of 36,790 cubic meters (48,100 cubic yards) each with a flow rate of 30 liters (8 gallons) per minute (DOE 2000f).

Liquid low-level radioactive waste is solidified before disposal. Low-level radioactive waste disposal occurs in pits and concrete-lined soil vaults in the subsurface disposal area of the Radioactive Waste Management Complex. Approximately 60 percent of the low-level radioactive waste generated at INL is treated for volume reduction prior to disposal at the Radioactive Waste Management Complex. Additionally, some low-level radioactive waste is shipped offsite to be incinerated, and the residual ash is returned to INL for disposal. The Radioactive Waste Management Complex is expected to be filled to capacity by the year 2030, although some proposals would close the low-level radioactive waste disposal facility by 2006.

3.2.11.4 Mixed Low-Level Radioactive Waste

Mixed low-level radioactive waste is divided into two categories for management purposes: alpha mixed low-level radioactive waste and beta-gamma mixed low-level radioactive waste. Most of the alpha mixed low-level radioactive waste stored at INL is waste that has been reclassified from mixed transuranic waste and is managed as part of the transuranic waste program. Therefore, this section deals only with beta-gamma mixed low-level radioactive waste.

Mixed low-level radioactive waste, including polychlorinated biphenyl–contaminated low-level radioactive waste, is stored at several onsite areas awaiting the development of treatment methods. Mixed low-level radioactive waste is stored at the Mixed Waste Storage Facility (or Waste Experimental Reduction Facility Waste Storage Building) and in portable storage units at the CITRC area. In addition, smaller quantities of mixed low-level radioactive waste are stored in various facilities at INL, including the Hazardous Chemical/Radioactive Waste Facility at INTEC and the Radioactive Sodium Storage Facility and Radioactive Scrap and Waste Storage Facility at MFC. Although mixed wastes are stored in many locations at INL, the bulk of that volume is solid waste stored at the Radioactive Waste Management Complex.

As part of the INL Site Treatment Plan and Consent Order required by the Federal Facility Compliance Act, preferred treatment options have been identified to eliminate the hazardous waste component for many types of mixed low-level radioactive waste. Mixed low-level radioactive waste is or will be processed to RCRA land disposal restrictions treatment standards through several treatment facilities. Those treatment facilities and the operational status of each follow: (1) Waste Experimental Reduction Facility Incinerator (shutdown), (2) Waste Experimental Reduction Facility Stabilization (operational),

(3) Test Area North cask dismantlement (operational), (4) Sodium Process Facility (standby), (5) High-Efficiency Particulate Air Filter Leach (operational), (6) Waste Reductions Operations Complex Macroencapsulation, (7) Debris Treatment (operational), and (8) Advanced Mixed Waste Treatment Project. Commercial treatment facilities are also being considered, as appropriate. Currently, limited amounts of mixed low-level radioactive waste are disposed of at Envirocare of Utah.

3.2.11.5 Hazardous Waste

Approximately 1 percent of the total waste generated at INL (not including liquid nonhazardous waste) is hazardous waste. Most of the hazardous waste generated annually at INL is transported offsite for treatment and disposal. Offsite shipments are surveyed to determine that the wastes have no radioactive content and, therefore, are not mixed waste. Highly reactive or unstable materials such as waste explosives are addressed on a case-by-case basis and are either stored, burned, or detonated, as appropriate.

3.2.11.6 Nonhazardous Waste

Approximately 90 percent of the solid waste generated at INL is classified as industrial waste and is disposed of onsite in a landfill complex in the Central Facilities Area or offsite at the Bonneville County landfill. The onsite landfill complex contains separate areas for petroleum-contaminated media, industrial waste, and asbestos waste. The onsite landfill is 4.8 hectares (12 acres), and is being expanded by 91 hectares (225 acres) to provide capacity for at least 30 years.

Sewage is disposed of in surface impoundments in accordance with terms of the October 7, 1992, Consent Order. Wastewater in the impoundments is allowed to evaporate, and the resulting sludge is placed in the landfill. Solids are separated and reclaimed where possible.

3.2.11.7 Waste Minimization

The DOE Idaho Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at INL. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The Idaho Operations Office published its first *Waste Minimization Plan* in 1990, which defined specific goals, methodologies, responsibilities, and achievements of programs and organizations. INL now promotes the incorporation of pollution prevention into all planning activities, as well as the concept that pollution prevention is integral to mission accomplishment. In 2002, INL reported 38 pollution prevention projects, which resulted in a waste reduction of 13,906 metric tons (34,306 tons). The cost of operations was decreased by more than $9 million. Examples of pollution prevention projects at INL include the fabrication of lead bricks from over 90,720 kilograms (200,000 pounds) of radioactively contaminated lead taken from dismantled casks and shielding, which were reused/recycled by the Idaho State University Accelerator Center and the sale of a variety of items including desks, chairs, used tires, scrap metal, and computer components to the public, resulting in avoided waste disposal costs of $5,472,772 and sales receipts of $294,284, which will be used toward INL Excess Warehouse operating expenses (DOE 2003c).

3.2.11.8 *Waste Management PEIS* Records of Decision

The *Waste Management PEIS* RODs affecting INL are shown in **Table 3–20**. Decisions on the various waste types were announced in a series of RODs published on the *Waste Management PEIS* (DOE 1997b). The initial transuranic waste ROD was issued on January 20, 1998 (63 FR 3629) with several subsequent amendments; the hazardous waste ROD was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste ROD was published on February 18, 2000 (65 FR 10061). The transuranic waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare transuranic waste for disposal at WIPP. Each DOE site that has or will generate transuranic waste will, as needed, prepare and store its transuranic waste onsite until the waste is shipped to WIPP. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of their nonwastewater hazardous waste, and ORR and the Savannah River Site (SRS) will continue to treat some of their own nonwastewater hazardous waste onsite in existing facilities, where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste ROD states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites and disposal will continue to the extent practicable onsite at INL, LANL, ORR, and SRS. In addition, the Hanford Site and Nevada Test Site (NTS) will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at the Hanford Site, INL, ORR, and SRS, and disposed of at the Hanford Site and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at INL is presented in the hazardous waste and low-level radioactive waste and mixed low-level radioactive waste RODs. Transuranic waste is currently being stored, pending shipment to WIPP for disposal (DOE 1996d).

Table 3–20 *Waste Management PEIS* Records of Decision Affecting Idaho National Laboratory

Waste Type	*Preferred Action*
Transuranic	Certify, dispose at WIPP.
Low-level radioactive	DOE has decided to treat INL's low-level radioactive waste onsite. [a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at INL. This includes the onsite treatment of INL's wastes and could include treatment of some mixed low-level radioactive waste generated at other sites. [a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of INL nonwastewater hazardous waste. DOE will also continue to use onsite facilities for wastewater hazardous waste. [b]

WIPP = Waste Isolation Pilot Plant, INL = Idaho National Laboratory.
[a] From the ROD for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[b] From the ROD for hazardous waste (63 FR 41810).
Sources: 63 FR 41810; 65 FR 10061.

3.2.12 Environmental Restoration Program

DOE is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at INL. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

EPA placed INL on the National Priorities List on December 21, 1989. In accordance with CERCLA, DOE entered into a consent order with EPA and the state of Idaho to coordinate cleanup activities at INL under one comprehensive strategy. This agreement integrates DOE's CERCLA response obligations with RCRA corrective action obligations. In 1991, DOE signed the Federal Facility Agreement and Consent Order with the EPA and the state of Idaho. In general, the agreement is designed to (DOE 2005a):

- Establish procedures and a schedule for prioritizing, implementing, and monitoring remediation in accordance with applicable Federal and State laws;

- Expedite remediation as much as possible to protect human health and the environment;

- Facilitate cooperation, information exchange, and participation between the agencies;
- Minimize duplication of analyses and documentation; and
- Provide opportunities for the public to stay informed and involved in selecting cleanup remedies.

Since the Federal Facility Agreement and Consent Order was signed in December 1991, INL has cleaned up thousands of unexploded World War II era munitions and removed tons of radioactively contaminated soil and out-of-service tanks. In addition, INL operates many treatment systems to clean up or destroy contaminants in and over the Snake River Plain Aquifer (DOE 2005a). Since 1991, 22 RODs have been signed and are being implemented, three remedial investigation/feasibility studies are under development, and more than 70 percent of CERCLA actions have been completed (DOE 2003c). The successful site cleanups have produced beneficial environmental impacts, including risk reductions.

The Federal Facility Agreement and Consent Order divided major INL facilities into 10 waste area groups (WAGs), each containing a number of areas potentially contaminated with hazardous waste. WAGs 1 through 9 correspond to facility areas at INL. WAG 10 corresponds to sitewide concerns and includes the Snake River Plain Aquifer. Contaminated areas found after a ROD is signed are included in WAG 10. WAGs are further broken down into operable units for management purposes (DOE 2005a).

Following a site investigation, and after the public is involved in selection of a remedy for a contaminated site, a ROD is issued that describes the remedy for the site in detail. Since the Federal Facility Agreement and Consent Order was signed in 1991, all but three RODs have been signed. The three remaining are also the most challenging and have been the focus of public concern. They are (DOE 2005a):

- Operable Unit 3-14, remediation of contaminated soils in and around the tank farm at the INTEC;
- Operable Unit 7-13/14, remediation of buried waste at the Radioactive Waste Management Complex's Subsurface Disposal Area; and
- Operable Unit 10-08, final comprehensive remediation of the Snake River Plain Aquifer and miscellaneous sites not covered within other WAGs.

Remediation activities at WAG 2 (RTC) are nearly complete. In 2002, investigation of newly identified sites that may contain contamination continued. Institutional controls were maintained, and an annual inspection report was published (DOE 2003c).

Contaminated sites at WAG 9 (MFC) include tanks and wastewater handling/disposal systems, such as ditches and ponds. DOE has been testing the use of plants to remove both radioactive and nonradioactive constituents from contaminated soils (i.e., phytoremediation) at several sites at MFC. The results are promising and have been supported through additional testing. The DOE Chicago Operations Office believes the remediation goals have been met at each of the sites, thereby excluding the need to continue with phytoremediation (DOE 2003c).

As directed by a ROD signed in 2000, MFC is treating the sodium-bonded spent nuclear fuel from EBR-II. Spent nuclear fuel from the reactor has been stored at MFC since the reactor was shut down in 1994. The treatment technology, in development for the last decade, is an electrometallurgical process that reduces overall volume and produces more stable waste forms. The process removes the reactive metal sodium component from the spent nuclear fuel and converts the long-lived transuranic elements and fission products into ceramic and metallic waste forms (INEEL 2003).

In May 2002, DOE, the Idaho Department of Environmental Quality, and the EPA signed a letter of intent formalizing an agreement to pursue accelerated risk reduction and cleanup at INL (DOE 2003c). The *Environmental Management Performance Management Plan for Accelerating Cleanup of the Idaho National Engineering and Environmental Laboratory* (DOE 2002b) describes DOE's plan to accelerate the reduction of environmental risk at INL by completing its cleanup responsibility faster and more efficiently. The plan describes how DOE will address risk reduction and elimination by stabilizing and dispositioning materials such as sodium-bearing liquid wastes, spent nuclear fuel, and special nuclear materials many years earlier than currently planned. The plan describes nine strategic initiatives DOE proposes to eliminate or reduce environmental risks at INL (DOE 2002b):

- Accelerate tank farm closure.
- Accelerate high-level radioactive waste calcine removal from Idaho.
- Accelerate consolidation of spent nuclear fuel to INTEC.
- Accelerate offsite shipments of transuranic waste stored at the Transuranic Storage Area.
- Accelerate remediation of miscellaneous contaminated areas.
- Eliminate onsite treatment and disposal of low-level radioactive waste and mixed low-level radioactive waste.
- Transfer all Environmental Management-managed special nuclear material offsite.
- Remediate buried waste at the Radioactive Waste Management Complex.
- Accelerate consolidation of INL facilities and reduce the footprint.

At the 2020 end state in the plan, some activities would continue: shipment of spent nuclear fuel to a repository; retrieval, treatment, packaging, and shipment of calcine high-level waste to a repository; and final dismantlement of remaining Environmental Management buildings. Additionally, the site will continue with ongoing activities such as groundwater monitoring well beyond the 2020 end state identified in the plan. These activities will be completed by 2035, with the exception of some minor activities leading to long-term stewardship (DOE 2002b). More information on regulatory requirements for waste disposal is provided in Chapter 5 of this EIS.

3.3 Los Alamos National Laboratory

LANL is located on approximately 26,480 acres (10,716 hectares) of land in north central New Mexico (**Figure 3–10**). The site is located 97 kilometers (60 miles) north-northeast of Albuquerque, New Mexico, 40 kilometers (25 miles) northwest of Santa Fe, New Mexico, and 32 kilometers (20 miles) southwest of Española, New Mexico. LANL is owned by the Federal Government and administered by DOE's National Nuclear Security Administration (NNSA). It is operated by the University of California under contract to DOE. Portions of LANL are located in Los Alamos and Santa Fe Counties. DOE's principal missions are national security, energy resources, environmental quality, and science, and each of these missions is supported by activities conducted at LANL.

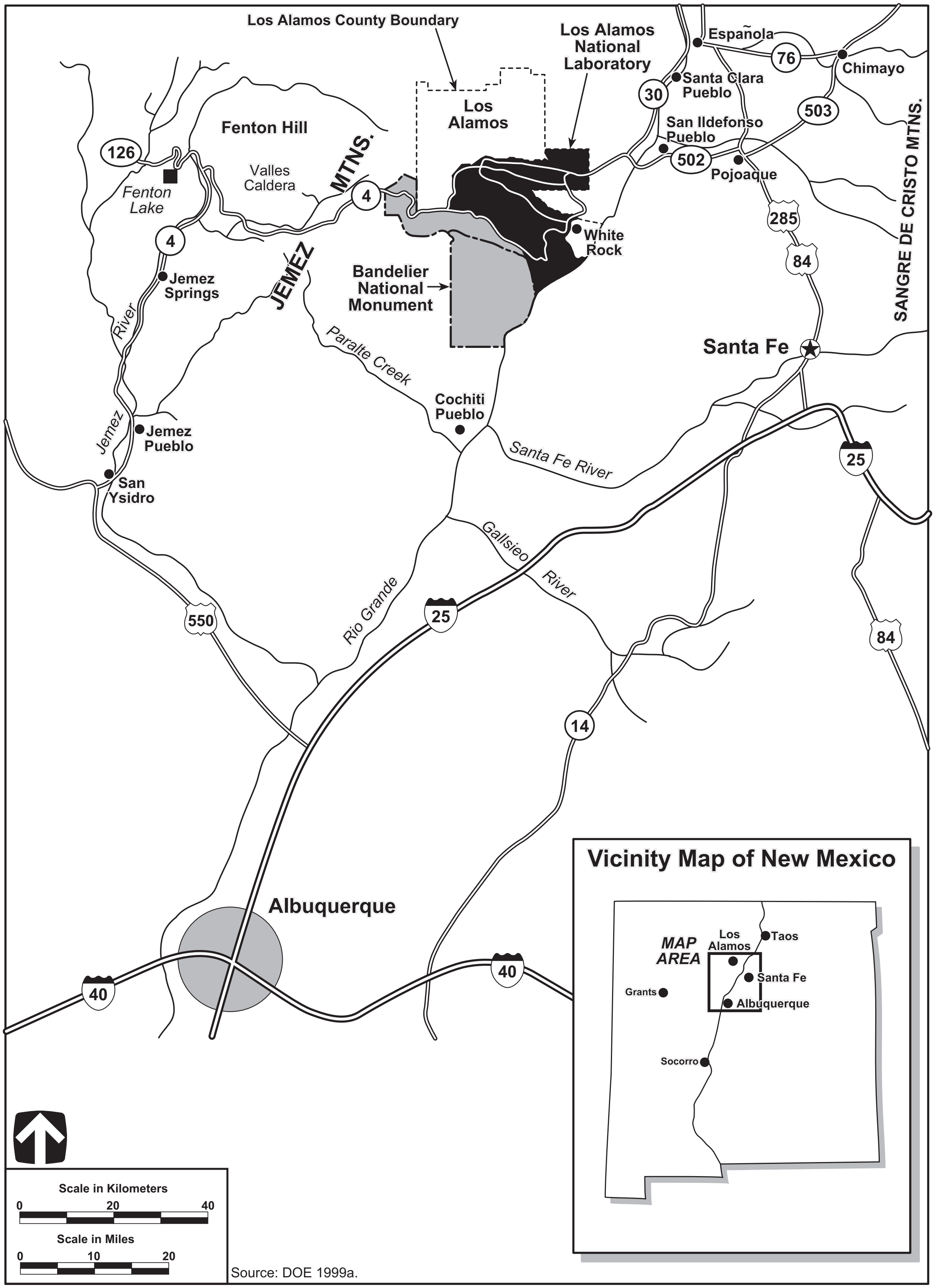

Figure 3–10 Los Alamos National Laboratory Vicinity

LANL is divided into 48 separate technical areas (TAs) not including TA-0 (which comprises leased space within the Los Alamos townsite), with location and spacing that reflect the site's historical development patterns, regional topography, and functional relationships (**Figure 3–11**). While the number of structures changes somewhat with time (e.g., as a result of the Cerro Grande Fire in 2000; see Section 4.2.1.1), there are 916 permanent structures, 512 temporary structures, and 1,362 miscellaneous buildings with approximately 538,000 square meters (5.8 million square feet) that could be occupied (LANL 2004a).

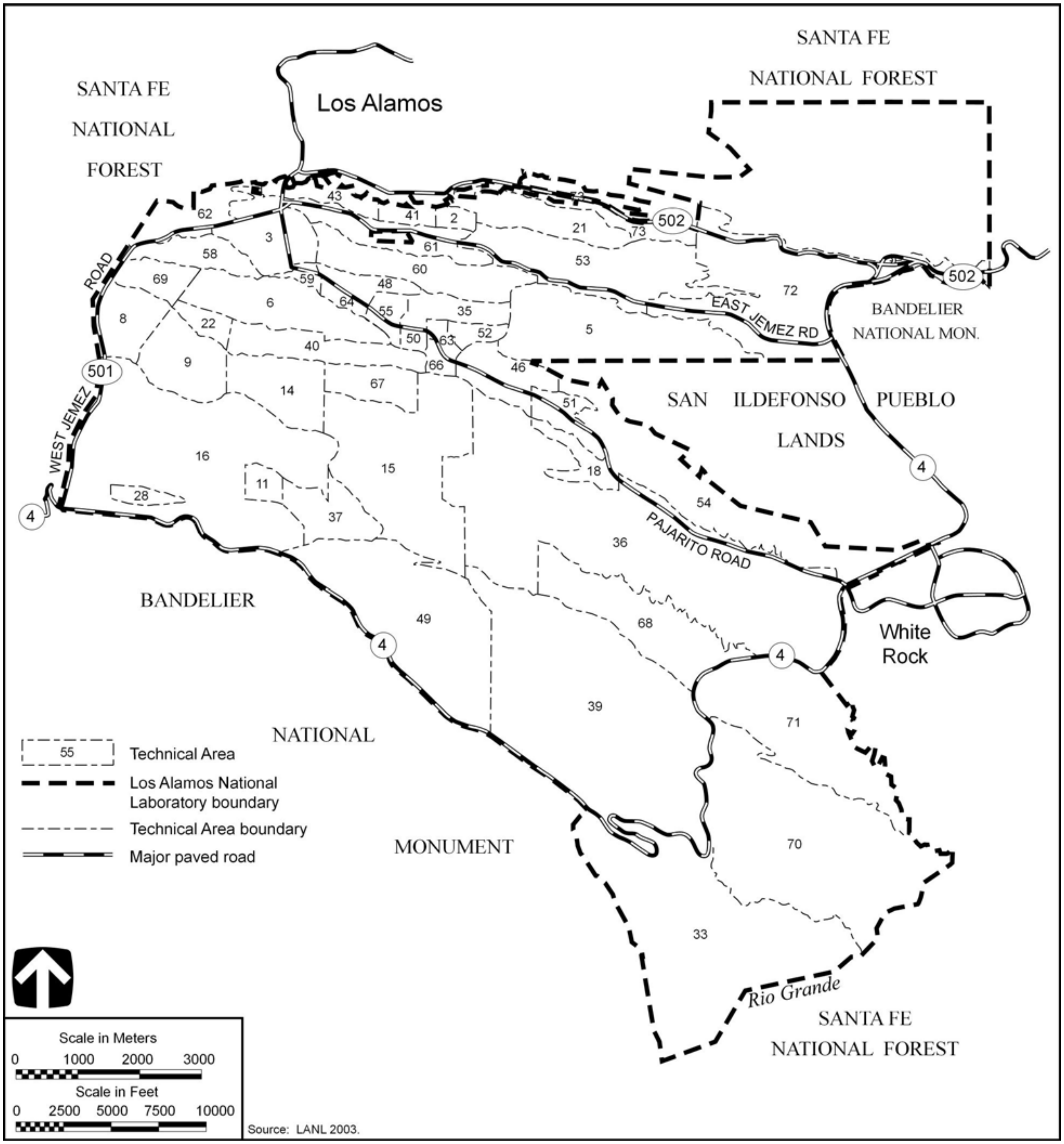

Figure 3–11 Technical Areas of Los Alamos National Laboratory

The Plutonium Facility at TA-55 at LANL is where plutonium-238 is currently purified, pelletized, and encapsulated. TA-55 is located in the west-central portion of LANL. The Plutonium Facility at TA-55 provides research and applications in chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides into many compounds and forms, as well as research into material properties and fabrication of parts for research and stockpile applications. Additional activities include the means to safely and securely ship, receive, handle, and store nuclear materials, as well as manage the waste and residue produced by TA-55 operations (DOE 1999a). Unless otherwise referenced, the following descriptions of the affected environment at LANL and TA-55 are based all or in part on information provided in the *LANL SWEIS* (DOE 1999a), which is incorporated by reference.

3.3.1 Land Resources

3.3.1.1 Land Use

Land use in this region is linked to the economy of northern New Mexico, which depends heavily on tourism, recreation, agriculture, and the state and Federal Governments for its economic base. Local communities are generally small, such as the Los Alamos townsite with under 12,000 residents, and primarily support urban uses including residential, commercial, light industrial, and recreational facilities. The region also includes American Indian communities; lands of the Pueblo of San Ildefonso share LANL's eastern border, and a number of other Pueblos are clustered nearby. Major governmental bodies that serve as land stewards and determine land uses within Los Alamos and Santa Fe Counties include the county governments, DOE, the U.S. Forest Service, the National Park Service, the state of New Mexico, the U.S. Bureau of Land Management, and several American Indian Pueblos. Bandelier National Monument and Santa Fe National Forest border LANL primarily to the southwest and northwest, respectively; however, small portions of each also border the site to the northeast (see **Figure 3–12**).

Land use characterization at LANL is based on the most hazardous activities in each TA and is organized into six categories:

Support—Includes TAs with only support facilities that do not perform research and development activities and are generally free from chemical, radiological, or explosive hazards; also includes undeveloped TAs other than those that serve as buffers.

Research and Development—Includes TAs that perform research and development activities with associated chemical and radiological hazards, but that are generally free of explosives hazards; does not include waste disposal sites.

Research and Development/Waste Disposal—The remaining research and development areas (i.e., those areas that are generally free of explosives hazards and have existing waste disposal sites).

Explosives—Includes TAs where explosives are tested or stored, but does not include waste disposal sites.

Explosives/Waste Disposal—The remaining sites where explosives are tested or stored (i.e., those with existing waste disposal sites).

Buffer—Land identified in each of the usage types described above also may serve as a buffer area. This last land use category therefore includes areas that serve only as buffers for the safety or security of other TAs, usually explosives areas.

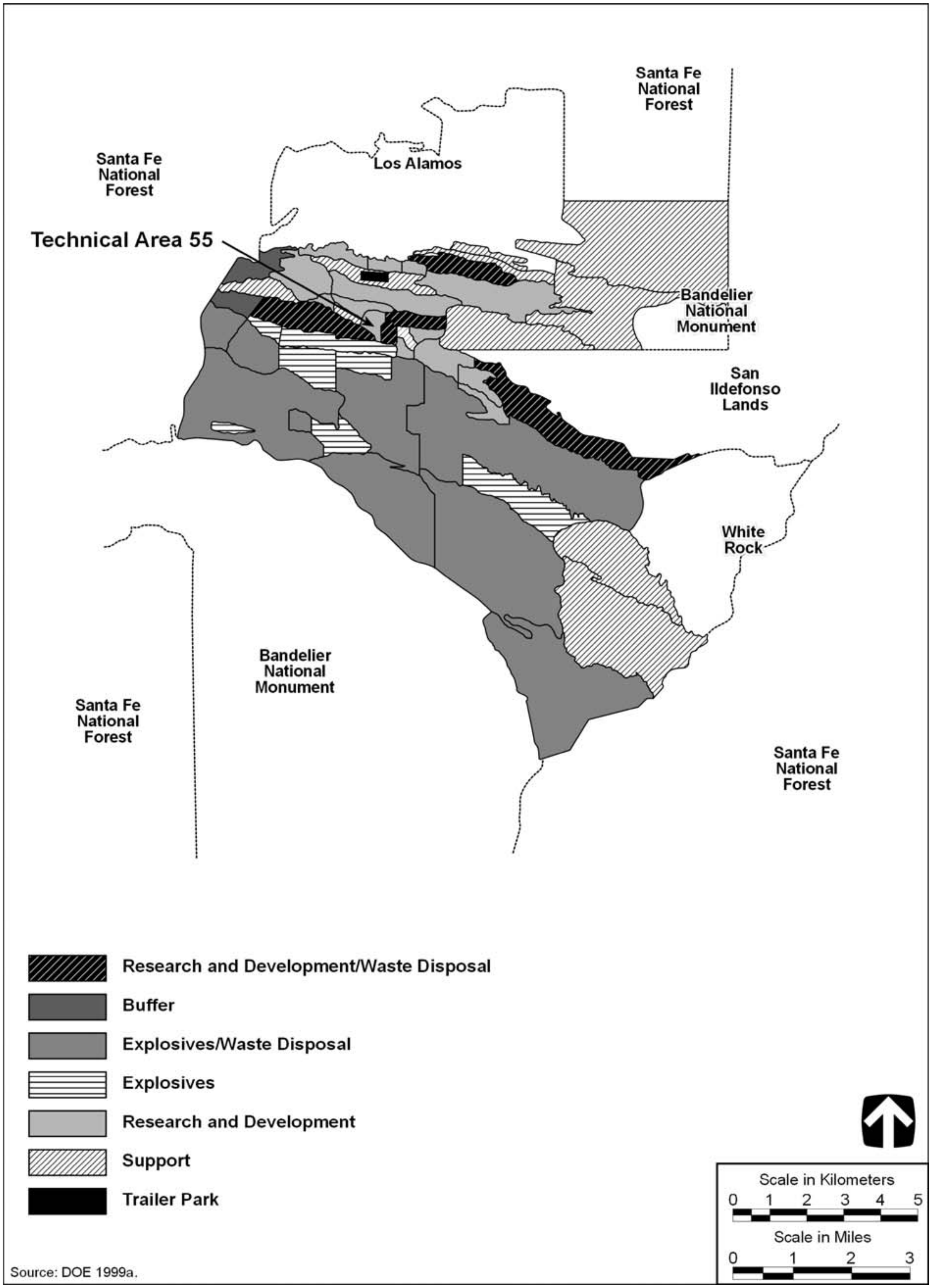

Figure 3–12 Land Use at Los Alamos National Laboratory

LANL is divided into TAs that are used for building sites, experimental areas, and waste disposal locations. However, those uses account for only a small part of the total land area of the site. In fact, only 5 percent of the site is estimated to be unavailable to most wildlife (because of security fencing). Most of the site is undeveloped to provide security, safety, and expansion possibilities for future mission requirements. There are no agricultural activities present at LANL, nor are there any prime farmlands. In 1977, DOE designated LANL as a National Environmental Research Park, which is used by the national scientific community as an outdoor laboratory to study the impacts of human activities on piñon-juniper woodland ecosystems (DOE 2002d). In 1999, the White Rock Canyon Wildlife Reserve was dedicated. It is about 405 hectares (1,000 acres) in size and is located on the southeast perimeter of LANL. The reserve is managed jointly by DOE and the National Park Service for its significant ecological and cultural resources and research potential (DOE 2003d).

Los Alamos County has prepared a preliminary draft of the *Los Alamos County Comprehensive Plan, 2001-2014* as part of the process to update its 1987 plan (previously addressed in the *LANL SWEIS*) (DOE 1999a, Los Alamos County 2004). The county consists of approximately 28,272 hectares (69,860 acres) of land, most of which is owned by the Federal Government. Only about 3,521 hectares (8,700 acres), including land that has been transferred from DOE (see below), are under county jurisdiction, with much of this land located within the Los Alamos townsite and White Rock. When Federal land changes ownership, the new owner is required to submit for general plan amendment and zoning before the land can be developed (Los Alamos County 2004). In 1999, Los Alamos County leased 16.8 hectares (41.5 acres) of land adjacent to TA-3 from LANL for development of a research park; to date, about 2 hectares (5 acres) have been developed (LANL 2003, 2005).

As a result of the passage of Public Law 105-119, Section 632, 10 tracts (consisting of 29 subtracts) comprising 1,952 hectares (4,824 acres) were designated for conveyance and transfer from DOE to the Incorporated County of Los Alamos and the Pueblo of San Ildefonso. However, the conveyance and transfer of 257 hectares (634 acres) has been deferred. Thus, the total land to be turned over totals 1,696 hectares (4,190 acres). To date, 894 hectares (2,209 acres) have been turned over, including all but 1.4 hectares (3.4 acres) to the Pueblo of San Ildefonso (LANL 2004a).

On the evening of May 4, 2000, employees of the National Park Service ignited a prescribed burn in a forested area approximately 2.2 kilometers (3.5 miles) west of LANL. The area of the burn was within the boundaries of Bandelier National Monument along a mountain slope of the Cerro Grande (DOE 2000d). The next day the fire was declared a wildfire. By the time it was fully contained on June 8, the fire had consumed approximately 17,400 hectares (43,000 acres), including about 3,035 hectares (7,500 acres) on LANL (LANL 2004a). Direct effects of the fire on land use included impacts on numerous site structures. Of the 332 structures affected by the fire, 236 were impacted, 68 damaged, and 28 destroyed (ruined beyond economic repair). Fire mitigation work, such as flood retention facilities, affected about 20.2 hectares (50 acres) of undeveloped land (LANL 2003). Following the fire, the Cerro Grande Rehabilitation Project was created to facilitate and implement post-fire activities. A *Wildfire Hazard Reduction Project Plan* (LANL 2001a) was developed to identify and prioritize projects and to provide guidelines for project implementation. This plan called for the treatment, including thinning of existing stands, of up to 4,047 hectares (10,000 acres) to reduce wildfire hazard. As of 2004, 2,947 hectares (7,283 acres) had been treated (LANL 2005).

TA-55 is also located within the Research and Development land use category (see Figure 3–12). Facilities at TA-55 are located on a 16-hectare (40-acre) site that is situated 1.8 kilometers (1.1 miles) south of the Los Alamos townsite. Forty-three percent of the site has been developed. The main complex has five connected buildings; the Nuclear Materials Storage Facility is separate from the main complex but shares an underground transfer tunnel. A security fence to aid in physical safeguarding of special nuclear material bounds the entire site. The Cerro Grande Fire at times threatened structures at TA-55 (LANL 2000b), however, no permanent buildings were damaged or destroyed.

3.3.1.2 Visual Resources

The topography in northern New Mexico is rugged, especially in the vicinity of LANL. Mesa tops are cut by deep canyons, creating sharp angles in the land form. Often, little vegetation grows on these steep slopes, exposing the geology, with contrasting horizontal planes varying from fairly bright reddish orange to almost white in color. A variety of vegetation occurs in the region, the density of vegetation and height of which may change over time and can affect the visibility of an area within the LANL viewshed. Undeveloped lands within LANL have a Bureau of Land Management Visual Resource Contrast rating of Classes II and III. Management activities within these classes may be seen but should not dominate the view (DOI 1986).

For security reasons, much of the development within LANL has occurred out of the public's view. Passing motorists or nearby residents can see only a small fraction of what is actually there. Prior to the Cerro Grande Fire, the view of most LANL property from many stretches of area roadways was that of woodlands and brushy areas. Views from various locations in Los Alamos County and its immediate surroundings have been altered by the Cerro Grande Fire. Although the visual environment is still diverse, interesting, and panoramic, portions of the visual landscape are dramatically stark. Rocky outcrops forming the mountains are now visible through the burned forest areas. The eastern slopes of the Jemez Mountains, instead of presenting a relatively uniform view of dense green forest, are now a mosaic of burned and unburned areas. Grasses and shrubs initially will replace forest stands and will contribute to the visual contrast between the burned and unburned areas for many years. Local effects include reduced visual appeal of trails and recreation areas (DOE 2000d).

The most visible developments at LANL are a limited number of very tall structures; facilities at relatively high, exposed locations; or those beside well-traveled, publicly accessible roads within the core part of LANL, the TA-3 area. Developed areas within LANL are consistent with a Class IV Visual Resource Contrast rating, in which management activities dominate the view and are the focus of viewer attention (DOE 2002d).

TA-55 is located on a mesa about 1.6 kilometers (1 mile) southeast of TA-3. While not visible from lower elevations, TA-55 is visible from higher elevations to the west along the upper reaches of the Pajarito Plateau rim, from where it appears as one of several scattered built-up areas among the heavily forested areas of the site. Developed portions of TA-55 have a Class IV Visual Resource Contrast rating (DOE 2002d).

3.3.2 Site Infrastructure

Characteristics of LANL's utility and ground transportation infrastructure are summarized in **Table 3–21**. Section 3.3.8.4 further discusses local transportation infrastructure, and Section 3.3.11 describes the site's waste management infrastructure.

3.3.2.1 Site Ground Transportation

LANL is accessible via NM Routes 4 and 502, with the central portion of LANL (including TA-55) accessible from the east from NM 4 via Pajarito Road which bisects the LANL site. About 130 kilometers (80 miles) of paved roads and parking surface have been developed on LANL. There is no railway service connection at the site.

Table 3–21 Los Alamos National Laboratory Sitewide Infrastructure Characteristics

Resource	*Site Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	130 [a]	Not applicable
Railroads (kilometers)	0	Not applicable
Electricity [b]		
Energy (megawatt-hours per year)	492,671	963,600
Peak load (megawatts)	88	110
Fuel		
Natural gas (cubic meters per year)	34,500,000 [c]	229,400,000 [d]
Liquid fuels (liters per year)	Negligible	Not limited
Water (liters per year)	1,430,000,000	2,050,000,000 [e]

[a] Includes paved roads and paved parking areas only.
[b] Usage and capacity values are for the entire Los Alamos Power Pool.
[c] Usage value for LANL plus baseline usage for other Los Alamos County users.
[d] Entire service area capacity which includes LANL and other Los Alamos area users.
[e] Equivalent to 30 percent of the water right allocation from the main aquifer.
Note: To convert kilometers to miles, multiply by 0.621; liters to gallons, multiply by 0.264; and cubic meters to cubic feet, multiply by 35.315.
Sources: DOE 2003d, LANL 2004b.

3.3.2.2 Electricity

Electrical service to LANL is supplied through a cooperative arrangement with Los Alamos County, known as the Los Alamos Power Pool, which was established in 1985. Electric power is supplied to the pool through two existing regional 115-kilovolt electric power lines. The first line (the Norton-Los Alamos line) is administered by DOE and originates from the Norton Substation near White Rock, and the second line (the Reeves Line) is owned by the Public Service Company of New Mexico and originates from the Bernalillo-Algodones Substation. Both substations are owned by the Public Service Company of New Mexico (DOE 2003d).

Import capacity is limited only by the physical capability (thermal rating) of the transmission lines. The import capacity is approximately 110 to 120 megawatts from a number of hydroelectric, coal, and natural gas power generators throughout the western United States (DOE 2003d, LANL 2004b).

Within LANL, DOE also operates a gas-fired steam and electrical power generating plant at TA-3 (TA-3 Co-generation Complex), and maintains various low-voltage transformers at LANL facilities and approximately 55 kilometers (34 miles) of 13.8-kilovolt distribution lines. DOE also maintains two power distribution substations: the Eastern TA Substation and the TA-3 Substation (DOE 2003d). As part of ongoing electric reliability upgrades at LANL, DOE completed construction of the new Western TA Substation in 2002. This 115/13.8-kilovolt substation has a main transformer rated at 56-megavolt-amperes (or about 45 megawatts). The substation will provide redundant capacity for LANL and the Los Alamos townsite in the event of an outage at either of LANL's two existing substations (DOE 2003d, LANL 2004b).

Other projects to improve the reliability of electric power transmission to the Power Pool include construction of a third transmission line and associated substation and uncrossing the two existing transmission lines (the Norton and Reeves Lines) where they cross on LANL. The new transmission line would be constructed in two segments: (1) from the Norton Substation to a new substation (Southern TA) to be constructed near White Rock, and (2) from the new Southern TA Substation to the Western TA

Substation. The first segment would be constructed at 345 kilovolts but operated in the short term at 115 kilovolts, as large pulse power loads at LANL will need the higher voltage in the future. The second segment would be constructed and operated at 115 kilovolts. Construction of the new transmission line and uncrossing the existing lines is projected to start in 2005 and require 1 year to complete (LANL 2004b).

Onsite electrical generating capability for the power pool is limited by the aforementioned TA-3 Co-generation Complex, which is capable of producing up to 20 megawatts of electric power that is shared by the Power Pool under contractual arrangement. Generally, onsite electricity production is used to fill the difference between peak loads and the electric power import capability (LANL 2004b). An environmental assessment was prepared and a Finding of No Significant Impact was issued in December 2002 for a project to install two new (20 megawatt), gas-fired combustion turbine generators and to upgrade the existing steam turbines. Refurbishment of this facility, which includes upgrades to the #3 steam turbine and to the steam path and cooling tower, began in 2003. When complete in Fiscal Year (FY) 2005, these improvements should increase the output of the facility to more than 20 megawatts in the short term. Installation of the first new combustion turbine generator at the TA-3 Co-generation Complex is scheduled to occur during the FY 2004 – FY 2005 timeframe (LANL 2004b).

Operations at several of the large LANL load centers changed during 2003. For example, operations at the Strategic Computing Complex resulted in load increases of about 4 megawatts in FY 2003 (LANL 2004b). Electrical energy availability from the Pool is estimated at 963,600 megawatt-hours (reflecting the lower thermal rating of 110 megawatts for 8,760 hours per year on the existing transmission system). In FY 2003, LANL used 382,849 megawatt-hours of electricity. Other Los Alamos County users consumed an additional 109,822 megawatt-hours, for a Power Pool total electric energy consumption of 492,671 megawatt hours. The FY 2003 peak load usage was about 71 megawatts for LANL and about 17 megawatts for the rest of the county (LANL 2004b). The estimated peak load capacity is 110 megawatts (see Table 3–21). TA-55 uses approximately 14,500 megawatt-hours of electricity annually (LANL 2003).

3.3.2.3 Natural Gas

Natural gas is the primary fuel used in Los Alamos County and at LANL. The natural gas system includes a high-pressure main and distribution system to Los Alamos County and pressure-reducing stations at LANL buildings. In August 1999, DOE sold the 209-kilometer-long (130-mile-long) main gas supply line and associated metering stations for Los Alamos and vicinity to the Public Service Company of New Mexico. The county and LANL both have delivery points where gas is monitored and measured. LANL burns natural gas to generate steam to heat buildings. The natural gas delivery system servicing the Los Alamos area has a contractually-limited capacity of about 229 million cubic meters (8.07 billion cubic feet) per year (DOE 2003d). In FY 2003, LANL used approximately 34.5 million cubic meters (1.22 billion cubic feet) of natural gas (see Table 3–21). Some 97 percent of the natural gas used at LANL is for heating, and the remainder for electricity generation to meet peak demands (LANL 2004b). The rest of the service area, including Los Alamos County, is estimated to use an average of 29.5 million cubic meters (1.04 billion cubic feet) of natural gas annually. Relatively small quantities of fuel oil are also stored at LANL as a backup fuel source and use is therefore negligible. TA-55 uses natural gas to fire boilers and for other facility uses and is estimated to use approximately 1.3 million cubic meters (45 million cubic feet) annually (DOE 2003d).

3.3.2.4 Water

The Los Alamos water supply system consists of 14 deep wells, 246 kilometers (153 miles) of main distribution lines, pump stations, and storage tanks. The system supplies potable water to all of the county, LANL, and Bandelier National Monument (DOE 2003d).

On September 5, 2001, DOE completed the transfer of ownership of the water production system to Los Alamos County, along with 70 percent (4,785 million liters [3,879 acre feet or 1,264 million gallons] per year) of its water rights. The remaining 30 percent (2,050 million liters [1,662 acre feet or 542 million gallons] per year) of the water rights are leased by DOE to the county for 10 years, with the option to renew the lease for four additional 10-year terms (DOE 2003d). The county is also pursuing the use of San Juan-Chama water as a means of preserving those water rights. Los Alamos County has completed a preliminary engineering study and is currently negotiating a contract to acquire this allocation (LANL 2004b).

In FY 2003, LANL used approximately 1,430 million liters (378 million gallons) of water (LANL 2004b) (see Table 3–21). Water use for TA-55 is not currently available.

3.3.3 Geology and Soils

3.3.3.1 Geology

LANL is located on the Pajarito Plateau within the Southern Rocky Mountains Physiographic Province. The Pajarito Plateau lies between the Sierra de Los Valles and the Jemez Mountains to the west and the Rio Grande to the east (see **Figure 3–13**). The surface of the Pajarito Plateau is divided into multiple narrow, east-southeast trending mesas separated by deep parallel canyons that extend from the Jemez Mountains to the Rio Grande. The major tectonic feature in the region is the Rio Grande Rift, which begins in northern Mexico, trends northward across central New Mexico, and ends in central Colorado. The rift is a complex system of north-trending basins that have formed from down-faulted blocks of the Earth's crust. In the Los Alamos area, the Rio Grande Rift is about 56 kilometers (35 miles) wide and encompasses the Española Basin. The Sangre de Cristo Mountains border the Rio Grande Rift on the east, and the Jemez Mountains lie west of the Rift and the Pajarito Fault system (DOE 2003d).

Bedrock outcrops typically occur on greater than 50 percent of the surface of LANL. Forming the Pajarito Plateau, the Bandelier Tuff consists of volcanic material that was violently erupted about 1.2 and 1.6 million years ago from the Valles and Toledo Calderas. In the LANL area, the Bandelier Tuff attains a thickness of more than 200 meters (700 feet) and consists of multiple ash-flow deposits of rhyolitic tuff and pumice. In particular, the Tshirege Member of the Bandelier Tuff consists of multiple cooling units that create nearly horizontal light- and dark-colored strata on canyon walls throughout the LANL area. The dark-colored units are harder and more resistant to erosion; they form steep cliffs and cap the mesas. Beneath the Bandelier Tuff, the Puye Formation is a complex deposit consisting predominantly of poorly sorted coarse sands to boulders resulting from erosion of the Jemez Mountains. This formation also includes ash and pumice falls from Jemez Mountain volcanism, inter-bedded basalt flows (the Cerros del Rio Basalt) and debris from the Cerros del Rio volcanic field (2 to 3 million years old), localized deposits of well-rounded cobbles and boulders of crystalline rocks from the ancestral Rio Grande, and fine-grained lake deposits in the eastern portions of the fan. The underlying Tschicoma Formation (2 to 7 million years old) consists of intermediate composition volcanic rocks and forms the bulk of the Jemez Mountains. The Santa Fe Group (4 to 21 million years old) is the thickest and most extensive group of sedimentary deposits in the upper Española Basin. In the vicinity of the Pajarito Plateau, the Santa Fe Group consists of two formations (Tesuque and overlying Chamita Formation) of slightly consolidated

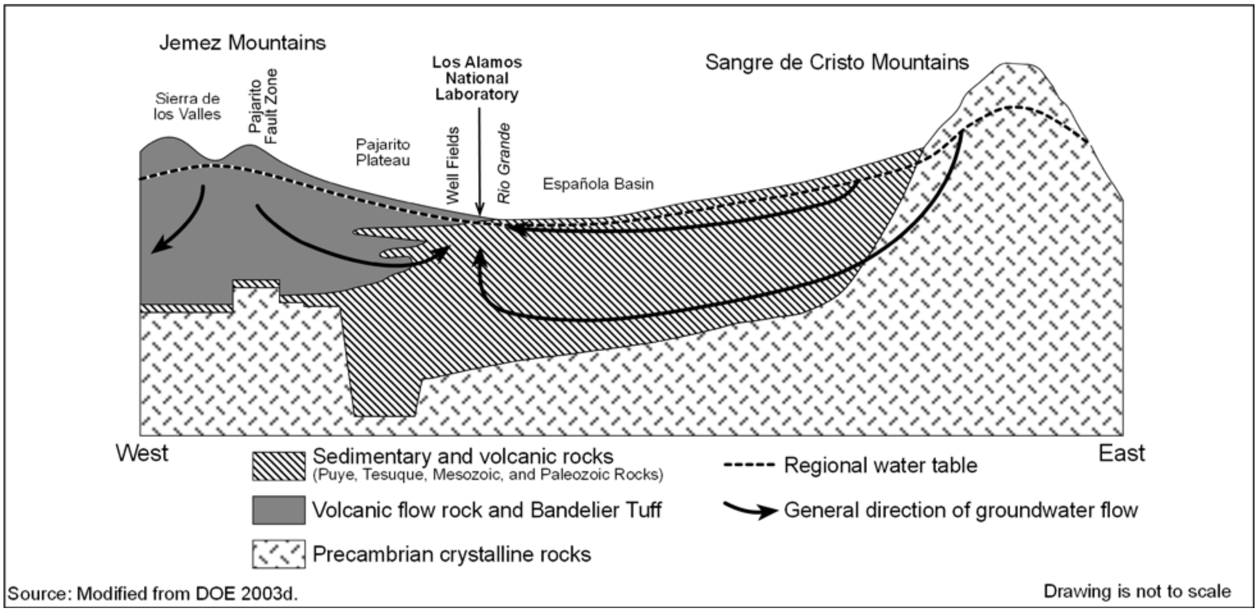

Figure 3–13 Geology and Hydrogeology of the Española Portion of the Northern Rio Grande Basin

sedimentary rocks derived from fluvial erosion of the Sangre de Cristo Mountains to the east. The Santa Fe Group also contains older volcanic tuff deposits and basalt flows, and overlies Precambrian Age (greater than 570 million years old) crystalline basement rock.

The Pajarito Fault system defines the western boundary of the Rio Grande Rift. In Los Alamos County, the Pajarito Fault system consists of the Pajarito, Rendija Canyon, and Guaje Mountain Fault zones (see **Figure 3–14**). Of these three fault zones, the Pajarito is the largest and delineates the boundary between the Pajarito Plateau and Jemez Mountains. The Rendija Canyon Fault changes from a single-trace in the northern part of Los Alamos County to a broad zone of smaller faults within LANL property. Locally, the Pajarito and Rendija Canyon Fault zones define a down-faulted block of the Bandelier Tuff that lies beneath the western part of the Los Alamos townsite and TA-3 (DOE 2003d). The three major faults in Los Alamos County are considered active and capable per the U.S. Nuclear Regulatory Commission definition of the term as used for seismic safety (DOE 2003d). A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years, or recurrent movement within the past 500,000 years (10 CFR Part 100).

Although LANL is located within an intracontinental rift zone, the region exhibits generally low seismicity overall. A historical catalog has been compiled of earthquakes that occurred in the LANL area from 1873 to 1991. Only six of these have had estimated magnitudes of 5 or greater on the Richter Scale. The May 1918 Cerrillos Earthquake was the most significant seismic event in this period. This earthquake had an estimated Richter magnitude of 5.5 and was centered approximately 50 kilometers (31 miles) southeast of LANL. This event had a reported MMI of VII at its epicenter (DOE 2002c, DOE 2003d). Since 1973, six earthquakes have been recorded within 100 kilometers (62 miles) of north-central LANL ranging in magnitude from 1.6 to a magnitude 4.5 event in March 1973. This 1973 earthquake was the closest to LANL at 27 kilometers (17 miles) to the northeast. The most recent was a magnitude 2.8 earthquake that occurred in December 1998 at a distance of 88 kilometers (55 miles) (USGS 2005c).

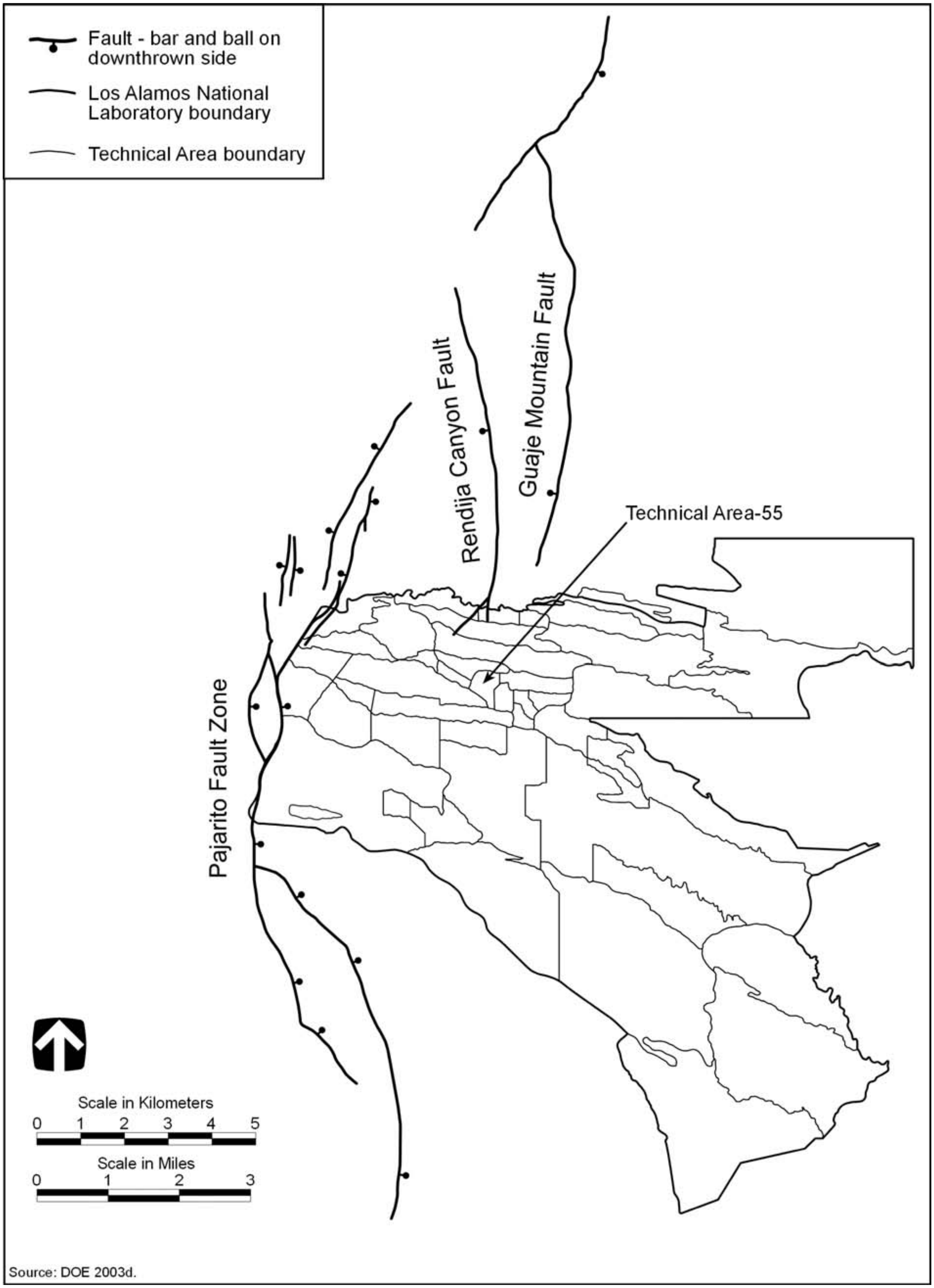

Figure 3–14 Major Faults at Los Alamos National Laboratory

Earthquake-produced ground motion is expressed in units of "g" (force of acceleration relative to that of the earth's gravity). Two differing measures of this motion are peak (ground) acceleration and response spectral acceleration. For north-central LANL facilities, the calculated maximum considered earthquake ground motion ranges from approximately 0.49g for a 0.2-second spectral response acceleration to 0.16g for a 1.0-second spectral response acceleration. The calculated peak ground acceleration for the given probability of exceedance at the site is approximately 0.20g (USGS 2005b). These are representative of MMI VII earthquake damage (BSSC 2004). Table B–7 in Appendix B of this EIS shows the approximate correlation between MMI, earthquake magnitude, and peak ground acceleration.

Seismic hazard analysis demonstrates that the highest seismic hazard at LANL would be to a site built atop a trace of the Pajarito Fault. Along the Pajarito Fault system, an earthquake with a magnitude greater than or equal to 6 is estimated to have an annual probability of occurrence of once every 4,000 years. An earthquake with a magnitude greater than or equal to 7 is estimated to have an annual probability of occurrence of once every 100,000 years (DOE 2003d). Maintenance and refurbishment activities at LANL are specifically intended to upgrade the seismic performance of older structures. As stated in DOE Order 420.1A, DOE requires that nuclear or nonnuclear facilities be designed, constructed, and operated so that the public, the workers, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Volcanism in the Jemez Mountains volcanic field, west of LANL, has a 13-million-year history. The Bandelier Tuff is the material upon which most LANL facilities are constructed. The Bandelier Tuff is generally thickest to the west of LANL near its source, and thins eastward across the Pajarito Plateau, due to increasing distance from the source and erosion. Volcanic eruptions continued up to about 520,000 years ago, followed by a 460,000-year period of dormancy. The most recent volcanic activity produced several rock units, including the El Cajete Pumice, which is a minor unit in the LANL area that overlays the Bandelier Tuff. The El Cajete Pumice dates at 50,000 to 60,000 years old (DOE 2002d). Several independent lines of evidence indicate that future volcanic activity in the Jemez Mountains is likely, but recurrence intervals have not been firmly established.

During seismic events, facilities near a cliff edge or in a canyon bottom below are potentially susceptible to slope instability, rock falls, and landslides. Slope stability studies have been performed at LANL facilities where a hazard has been identified. As for other geologic hazards due to seismic activity, the potential for land subsidence and soil liquefaction at LANL are considered low and negligible, respectively (DOE 2003d).

3.3.3.2 Soils

Several distinct soils have developed in Los Alamos County as a result of interactions between the bedrock, topography, and local climate. Most soils developed from acidic volcanic rock and range in texture from clay and clay loam to gravel. Soils that formed on mesa tops are well drained and range from 0 to 102 centimeters (0 to 40 inches) deep, with the greatest depth to the underlying Bandelier Tuff being 102 centimeters (40 inches). Soil erosion rates vary considerably on the mesa tops at LANL, with the highest rates occurring in drainage channels, where roads and structures concentrate runoff, and in areas of steep slopes, and the lowest rates occurring on gently sloping portions of the mesa tops away from the channels. High erosion rates appear to be relatively recent, most likely resulting from loss of vegetative cover, decreased precipitation, past logging practices, and past livestock grazing. Site soils are acceptable for standard construction techniques. No prime farmland soils have been designated in Los Alamos County (DOE 2002d, DOE 2003d).

The May 2000 Cerro Grande Fire burned the east-facing slope of the Jemez Mountains immediately upslope of LANL. The fire also burned significant areas within the western and central portions of the site. The loss of ground cover vegetation due to the fire increased the potential for soil erosion in these areas. Following the fire, the U.S. Forest Service Burn Area Emergency Rehabilitation Team found no significant areas of hydrophobic (water repellent) soil conditions within LANL. Regardless, due to exposed soils in the Jemez Mountains upslope of LANL, prevention of possible flooding of high-risk LANL facilities during intense precipitation events became a high priority. The possibility for enhanced erosion will likely persist for some 3 to 5 years (DOE 2003d).

TA-55 is located just to the southwest of the southern terminus of the Rendija Canyon Fault, which is located approximately 1.3 kilometers (0.8 miles) northwest of the facility. The Guaye Mountain Fault Zone dies out within the Los Alamos townsite approximately 3.2 kilometers (2 miles) north-northeast of TA-55; it has not been identified within LANL. TA-55 is located within an area of relatively simple structure where virtually no fault deformation can be documented. Detailed mapping has shown that the closest fault (not shown on Figure 3–14) is located 0.28 miles (0.45 kilometers) west of the Plutonium Facility at TA-55 (DOE 2003d). Typical subsurface stratigraphy at LANL and TA-55 consists of welded and poorly welded volcanic tuffs that comprise the Tshirege Member of the Bandelier Tuff Formation. The Tshirege Member attains a thickness of about 122 meters (400 feet). Site-specific investigations in Pajarito Canyon near TA-18 have found the tuff to be highly weathered and unwelded, with the upper 3 to 4.5 meters (10 to 15 feet) of the material classified as clayey sand or sandy clay. The canyon tuff is overlain by up to 4.5 meters (15 feet) of sandy and silty alluvium. Soils derived from these deposits are typically sandy loams (DOE 2002e).

3.3.4 Water Resources

3.3.4.1 Surface Water

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams (i.e., arroyos). Perennial springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons, but the volume is insufficient to maintain surface flows across the LANL site before they are depleted by evaporation, transpiration, and infiltration. Runoff from heavy thunderstorms or snowmelt reaches the Rio Grande, the major river in north-central New Mexico, several times a year in some drainages. Effluent from sanitary sewage, industrial water treatment plants, and cooling-tower blowdown enter some canyons at rates sufficient to maintain surface flows for varying distances. Major watersheds in the LANL region are shown in **Figure 3–15**. All of these watersheds are tributaries to an 18-kilometer (11-mile) segment of the Rio Grande (DOE 2003d).

The Pajarito Plateau Canyons, which serve as collection points for the regional watersheds, originate either along the eastern rim of the Sierra de Los Valles or on the Pajarito Plateau. Within LANL boundaries, only Los Alamos, Pajarito, Water, Ancho, Sandia, Pueblo, and Chaquehui Canyons contain reaches or streams with sections that have continuous flow. Intermittent streams within LANL property are not classified, but are protected by the state of New Mexico for livestock watering and wildlife habitat use (New Mexico Administrative Code 20.6.4.10). Surface water within LANL boundaries is not a source of municipal, industrial, or irrigation water, but is used by wildlife that lives within, or migrates through, the region (DOE 2003d).

Most of LANL effluent is discharged into normally dry arroyos, and LANL is required to meet effluent limitations under the NPDES permit program that requires routine effluents monitoring. Therefore, the water quality of the intermittent streams is more characteristic of the quality of these discharges than of natural runoff, as reflected in the results of 2003 surface water and runoff monitoring. LANL's current individual NPDES permit (No. NM0028355), which was reissued with an effective date of February 1, 2001, covers all onsite industrial and sanitary effluent discharges, and DOE/NNSA and the

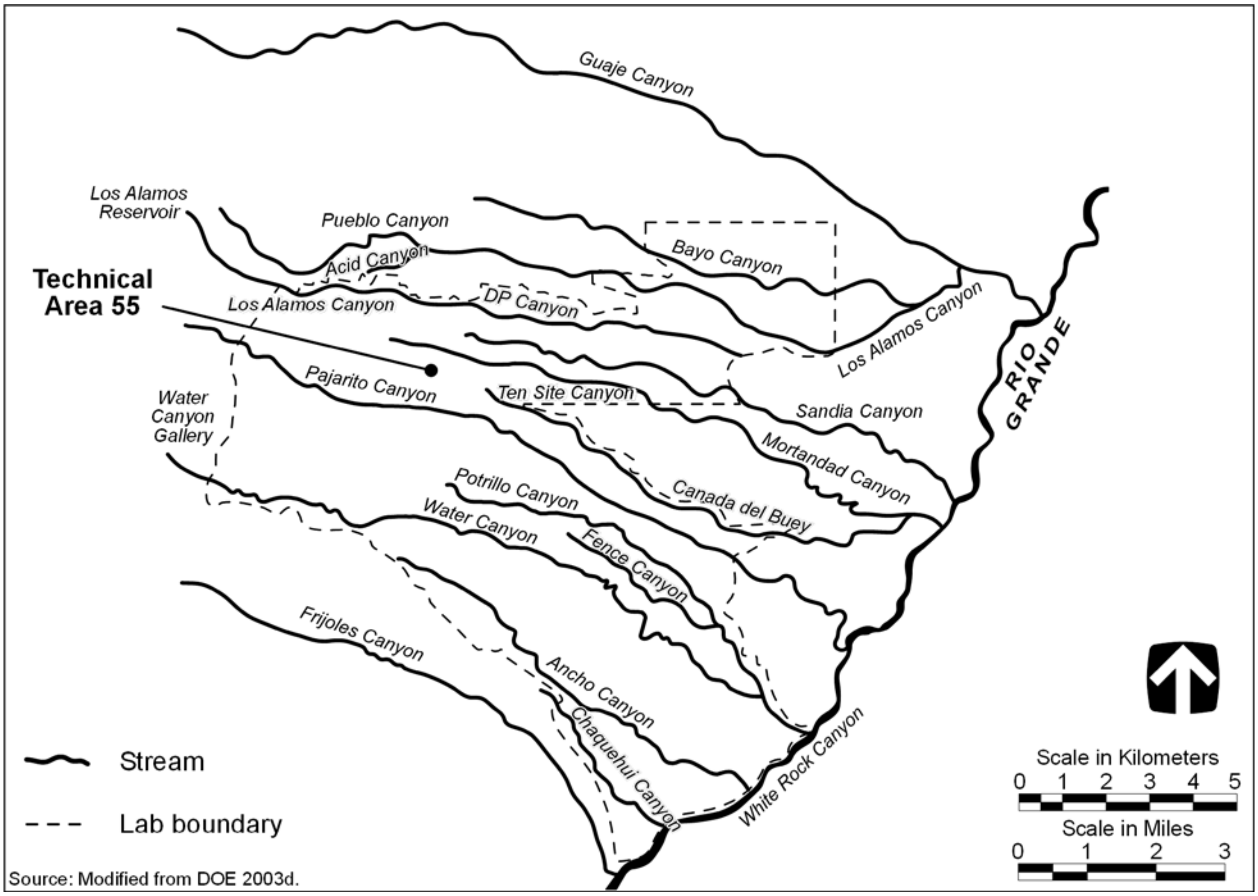

Figure 3–15 Surface Water Features at Los Alamos National Laboratory

University of California are co-permittees. As a result of an ongoing outfall reduction program that includes removing process flows at industrial outfalls, LANL's current industrial point-source NPDES permit now contains 21 permitted outfalls that include 1 sanitary outfall and 20 industrial outfalls.

The NPDES Industrial Storm Water Permit Program regulates storm water discharges from identified industrial activities. The University of California and DOE are also co-permittees under the NPDES Storm Water Multi-Sector General Permit 2000 (published in 2000) for LANL. The permit regulates storm water discharges from LANL industrial activities. The permit also requires the development and implementation of an SWPP Plan. Currently, LANL maintains and implements 17 SWPP Plans for its industrial activities. LANL also conducts stream monitoring and storm water monitoring at the confluence of major canyons, in certain segments of these canyons, and at a number of site-specific facilities. In addition, LANL conducts voluntary monitoring in major canyons that enter and leave LANL property (LANL 2004c).

LANL monitors surface waters and channel sediments from regional and Pajarito Plateau stations to evaluate the environmental effects of facility operations. Historical activities and resulting effluent discharges have affected water courses and associated sediments particularly in Pueblo, Los Alamos, Sandia, and Mortandad Canyons and, consequently, continue to affect surface water and runoff quality in these areas. The overall quality of most surface water in the Los Alamos area is very good, with very low levels of dissolved solutes. Of the more than 100 analytes tested for in sediment and surface water within the Laboratory, most are within normal ranges or at concentrations far below regulatory standards or risk-based advisory levels. However, nearly every major watershed shows indications of some effect from

LANL operations. At monitoring locations below other industrial or residential areas, particularly in the Los Alamos and Pueblo Canyon watersheds, above background contaminant levels reflect contributions from non-Laboratory sources, such as urban runoff.

The University of California at LANL has delineated all 100-year floodplains within LANL boundaries, which are generally associated with canyon drainages. Overall, most laboratory development is on mesa tops, and development within canyons is light. Nevertheless, for practical purposes the Cerro Grande Fire has increased the extent of all delineated floodplains in and below burned watershed areas (i.e., predominantly Los Alamos, Sandia, Mortandad, Pajarito, and Water Canyons) due to vegetation loss. More storm water runoff reaches the canyon bottoms and could subject LANL facilities located within or near the prefire delineated floodplain areas to increased erosion or sediment and debris deposition (DOE 2003d).

TA-55 is located on a narrow mesa (Mesita del Buey) about 1 mile (1.6 kilometers) southeast of TA-3. The mesa is flanked by Mortandad Canyon to the north and Twomile Canyon to the south. The site is largely comprised of a heavily developed facility complex with surface drainage primarily occurring as sheet flow runoff from the impervious surfaces within the complex. No developed portions of the complex are located within a delineated floodplain. One TA-55 facility discharges cooling tower blowdown directly to Mortandad Canyon (via NPDES Outfall 03A181). The Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50, specifically receives and treats plutonium processing and other wastes from TA-55 facilities with effluent discharged via NPDES Outfall 051 to Mortandad Canyon (DOE 2003d, NMED 2004).

3.3.4.2 Groundwater

Groundwater in the Los Alamos area occurs as perched groundwater near the surface in shallow canyon bottom alluvium and at deeper levels in the main (regional) aquifer. All groundwater underlying LANL and the vicinity having a total dissolved solids concentration of 10,000 milligrams per liter or less is considered a potential source of water supply for domestic or other beneficial use (New Mexico Administrative Code 20.6.2.3000).

The locations and extent of perched groundwater bodies have not been fully characterized at LANL, but investigations are continuing, and unidentified perched aquifers may exist. The depth to perched groundwater from the surface ranges from approximately 27 meters (90 feet) in the middle of Pueblo Canyon to about 150 to 200 meters (500 to 700 feet) in Mortandad Canyon. The regional aquifer exists in the sedimentary and volcanic rocks of the Española Basin, with a lateral extent from the Jemez Mountains in the west to the Sangre de Cristo Mountains in the east (see Figure 3–13). The hydrostratigraphic (water-bearing) units comprising the regional aquifer include the interconnected Puye Formation and the Tesuque Formation of the Santa Fe Group, with the top of the aquifer originating in the Cerros del Rio basalt, rather than in the Puye Formation, in some locations. Groundwater flow paths are conceptually illustrated in Figure 3–13. Groundwater flow is generally to the east across LANL toward the Rio Grande (DOE 2003d). Flow rates in the regional aquifer vary spatially but are typically 9 meters (30 feet) per year (LANL 2004c).

The regional aquifer is hydraulically separated for practical purposes from the overlying alluvial and intermediate perched groundwater bodies by unsaturated volcanic tuff and sedimentary strata, with the regional water table surface lying at a depth below land surface that varies from approximately 366 meters (1,200 feet) along the western boundary of the Pajarito Plateau to approximately 183 meters (600 feet) along its eastern edge. Thus, these hydrogeologic conditions tend to insulate the regional aquifer from near-surface waste management activities. Water in the regional aquifer is under confined, artesian conditions under the eastern part of the Pajarito Plateau near the Rio Grande (DOE 2003d).

Short-term effects of the Cerro Grande Fire on LANL groundwater resources include a potential increase in the prevalence of perched groundwater and springs. Also, the liberation of organic nitrogen from burned soils could impact shallow groundwater in the perched and alluvial zones, although the effects on deeper groundwater resources are not known (DOE 2003d).

Groundwater monitoring is conducted within and near LANL and encompasses the perched alluvial zone, intermediate perched groundwater zone, regional aquifer, and springs. However, although largely insulated from effects resulting from surface activities by hydrogeologic conditions, resource management and protection efforts are focused on the regional aquifer, which is the source for the Los Alamos public water supply. The groundwater monitoring network for perched alluvial groundwater consists of shallow observation wells located in Mortandad, Los Alamos, Pueblo, and Pajarito Canyons and in Cañada del Buey. The monitoring network for the regional aquifer includes monitoring (test) wells, 12 deep supply wells that produce water for all of LANL and the surrounding communities, and numerous springs, including those in White Rock Canyon along the Rio Grande. Los Alamos County owns and operates LANL's water supply wells and is responsible for demonstrating that the supply system meets Safe Drinking Water Act requirements (LANL 2004c).

As previously indicated, liquid effluent disposal at the Laboratory has significantly affected the quality of alluvial groundwater in some canyons. These effluents have affected deeper intermediate perched groundwater and the regional aquifer to a lesser degree. Drainages that received liquid radioactive effluents include Mortandad Canyon, Pueblo Canyon from its tributary Acid Canyon, and Los Alamos Canyon from its tributary DP Canyon. Water Canyon and its tributary Cañon de Valle have received effluents produced by high explosive processing and experimentation. Most notably, Mortandad Canyon presently receives radioactive effluents from the TA-50 RLWTF from its tributary Effluent Canyon. The radionuclide constituents in the RLWTF effluent have often exceeded the DOE Derived Concentration Guides for public dose from drinking water. The effluent also contains nitrate and fluoride that formerly caused perched alluvial groundwater concentrations to exceed the New Mexico groundwater standards of 10 milligrams per liter and 1.6 milligrams per liter, respectively. The nitrate source is nitric acid from plutonium processing at TA-55 that enters the TA-50 waste stream (DOE 2003d, LANL 2004c). Across the site, elevated perched alluvial groundwater concentrations of strontium-90, plutonium, americium, tritium, nitrate, perchlorate, high-explosives, barium, and molybdenum have approached or exceeded drinking water standards or risk-based drinking water levels in recent years in a few locations and over a limited area. Further, intermediate perched groundwater concentrations of high explosives, chlorinated solvents, tritium, perchlorate, and nitrate exceed or approach drinking water standards or risk-based drinking water levels in a few locations onsite. The regional aquifer shows traces of tritium and nitrate that are below drinking water risk levels. However, significant improvements in the water quality of most liquid effluent discharges from LANL facilities have with some exceptions (such as strontium-90) resulted in rapid improvement in the quality of shallow groundwater (LANL 2004c).

A reverse osmosis and ultrafiltration treatment system that removes additional radionuclides and nitrate from the effluent began operation in April 1999. As a result, effluent discharges from the RLWTF now meet the DOE Derived Concentration Guides for public dose and New Mexico standards for nitrate and fluoride; the RLWTF effluent has met DOE Derived Concentration Guides continuously since December 10, 1999. Also, at the end of 2000, the RLWTF adopted a voluntary goal of tritium activity below 20,000 picocuries per liter in its effluent (LANL 2004c). Detailed information on groundwater monitoring, including analytical results, is presented in the annual site environmental report.

The main aquifer is the only body of groundwater in the region that is sufficiently saturated and permeable to transmit economic quantities of water to wells for public use. All drinking water for Los Alamos County, LANL, and Bandelier National Monument comes from the main aquifer. Water use is detailed in Section 3.3.2.4.

The depth to groundwater beneath TA-55 is approximately 390 meters (1,280 feet) and the flow direction is inferred as east and southeast. As discussed above, radioactive effluents from TA-3 and TA-55 are conveyed through RLWTF at the TA-50 wastewater treatment facility and then discharged to Mortandad Canyon (DOE 2003d). Effluent discharge from the RLWTF into Mortandad Canyon had created a localized area of alluvial groundwater with plutonium-238, -239, -240, and americium-241 measured above the 4-millirem DOE Derived Concentration Guide for drinking water.

3.3.5 Air Quality and Noise

3.3.5.1 Air Quality

Los Alamos has a semiarid, temperate mountain climate. This climate is characterized by seasonable, variable rainfall with precipitation ranging from 25 to 51 centimeters (10 to 20 inches) per year. The climate of the Los Alamos townsite is not as arid (dry) as the portions of LANL near the Rio Grande, which is arid continental. Meteorological conditions within Los Alamos are influenced by the elevation of the Pajarito Plateau. Climatological averages presented for atmospheric variables such as temperature, pressure, winds, and precipitation are based on observations made at the official Los Alamos meteorological weather station from 1971 to 2000. Normal (30-year mean) minimum and maximum temperatures for the community of Los Alamos range from a mean low of -8.1 °C (17.4 °F) in January to a mean high of 27 °C (80.6 °F) in July. Normal (30-year mean) minimum and maximum temperatures for the community of White Rock range from a mean low of -9.7 °C (14.6 °F) in January to a mean high of 29.8 °C (85.6 °F) in July. Temperatures in Los Alamos vary with altitude, averaging 3 °C (5 °F) higher in and near the Rio Grande Valley, which is 1,981 meters (6,500 feet) above sea level, and 3 to 5.5 °C (5 to 10 °F) lower in the Jemez Mountains, which are 2,600 to 3,050 meters (8,500 to 10,000 feet) above sea level. Los Alamos townsite temperatures have dropped as low as -28 °C (-18 °F) and have reached as high as 35 °C (95 °F). The normal annual precipitation for Los Alamos is approximately 48 centimeters (19 inches). Annual precipitation rates within the county decline toward the Rio Grande Valley, with the normal precipitation for White Rock at approximately 34 centimeters (14 inches). The Jemez Mountains receive over 64 centimeters (25 inches) of precipitation annually. The lowest recorded annual precipitation in Los Alamos townsite was 17 centimeters (7 inches) and the highest was 76 centimeters (30 inches).

Thirty-six percent of the annual precipitation for Los Alamos County and LANL results from thundershowers that occur in July and August. Winter precipitation falls primarily as snow. Average annual snowfall is approximately 150 centimeters (59 inches), but can vary considerably from year to year. Annual snowfall ranges from a minimum of 24 centimeters (9 inches) to a maximum of 389 centimeters (153 inches).

Los Alamos County winds average 3 meters per second (7 miles per hour). Wind speeds vary throughout the year, with the lowest wind speeds occurring in December and January. The highest winds occur in the spring (March through June), due to intense storms and cold fronts. The highest recorded wind in Los Alamos County was 34 meters per second (77 miles per hour). Surface winds often vary dramatically with the time of day, location, and elevation, due to Los Alamos' complex terrain.

In addition to seasonal changes in wind conditions, surface winds often vary with the time of day. An up-slope air flow often develops over the Pajarito Plateau in the morning hours. By noon, winds from the south usually prevail over the entire plateau. The prevalent nighttime flow ranges from the west-southwest to northwest over the western portion of the plateau. These nighttime winds result from cold air drainage off the Jemez Mountains and the Pajarito Plateau. Analyses of Los Alamos Canyon wind data indicate a difference between the atmospheric flow in the canyon and the atmospheric flow over the Pajarito Plateau. Cold air drainage flow is observed about 75 percent of the time during the night and continues for an hour or two after sunrise until an up-canyon flow forms. Wind conditions are discussed further in the *LANL SWEIS* (DOE 1999a).

Thunderstorms are common in Los Alamos County, with an average of 60 thunderstorms occurring in a year. Lightning can be frequent and intense. The average number of lightning-caused fires in the 1,104 hectares (2,727 acres) of Bandelier National Monument for the years 1990 through 1994 was 12 per year. There are no recorded instances of large-scale flooding in Los Alamos County. However, flash floods from heavy thunderstorms are possible in areas such as arroyos, canyons, and low-lying areas. No tornadoes are known to have touched the ground in the Los Alamos area.

Nonradiological Releases

LANL operations can result in the release of nonradiological air pollutants that may affect the air quality of the surrounding area. LANL is within the Upper Rio Grande Valley Intrastate Air Quality Control Region (#157). The area encompassing LANL and Los Alamos County is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and particulate matter) (40 CFR 81.332).

In addition to the NAAQS established by the EPA, the state of New Mexico has established ambient air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, total suspended particulates, hydrogen sulfide, and total reduced sulfur. Additionally, New Mexico established permitting requirements for new or modified sources of regulated air pollutants. Air quality permits have been obtained from the State Air Quality Bureau for beryllium operations, a rock crusher, and LANL's power plant that were modified or constructed after August 31, 1972. In accordance with Title V of the Clean Air Act, as amended, and New Mexico Administrative Code 202.72.402, the University of California and DOE submitted a sitewide operating permit application to the New Mexico Environment Department (NMED) in December 1995. In 2002, the University of California and DOE submitted a revised operating permit application as requested by NMED. NMED issued a Notice of Completeness for both applications and issued Operating Permit P100 in April 2004.

Criteria pollutants released from LANL operations are emitted primarily from combustion sources such as boilers, emergency generators, and motor vehicles. **Table 3–22** presents information regarding the primary existing sources. Toxic air pollutant emissions from LANL activities are released primarily from laboratory, maintenance, and waste management operations. Unlike a production facility with well-defined operational processes and schedules, LANL is a research and development facility with great fluctuations in both the types of chemicals emitted and their emission rates. DOE has a program to review new operations for their potential to emit air pollutants.

Only limited monitoring of the ambient air has been performed for nonradiological air pollutants within the LANL region. The NMED operated a DOE-owned ambient air quality monitoring station adjacent to Bandelier National Monument between 1990 and 1994 to record sulfur dioxide, nitrogen dioxide, ozone, and particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) levels (see **Table 3–23**). LANL and the NMED discontinued operation of this station in FY 1995 because recorded values were well below applicable standards. Beryllium monitoring performed in 1999 at 9 onsite stations, 10 perimeter stations, and 6 regional stations showed that beryllium levels were low. The New Mexico beryllium ambient standard has been repealed.

Table 3–22 Air Pollutant Emissions at Los Alamos National Laboratory in 1999

Pollutant	*LANL Sources other than TA-55 (metric tons per year)* [a]	*TA-55 Sources (metric tons per year)*
Carbon monoxide	24.6	4.44
Nitrogen dioxide	73.5	5.97
PM_{10}	3.66	0.402
Sulfur dioxide	0.474	0.021

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
[a] Emissions from the following were included: TA-3 Steam Plant, TA-21 Steam Plant, TA-16 Boilers, TA-48 Boiler, TA-53 Boiler, TA-59 Boiler, paper shredder, TA-3 Asphalt Plant, and TA-54 Water Pump. The inventory did not include various small sources such as residential-size boilers and standby emergency generators.
Note: To convert from metric tons to (short) tons, multiply by 1.1023.
Sources: DOE 2002d.

Table 3–23 Nonradiological Ambient Air Monitoring Results

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*Ambient Concentration* [b] *(micrograms per cubic meter)*
Sulfur dioxide	Annual 24 hours 3 hours	41 [c] 205 [c] 1,030 [d]	2 18 Not applicable
Nitrogen dioxide	Annual 24 hours	73.7 [c] 147 [c]	4 9
Ozone	1 hour	185 [d]	138
PM_{10}	Annual 24 hours	50 [d] 150 [d]	8 29

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
[a] The most stringent of the state and Federal standards are shown.
[b] 1994 ambient concentrations from monitoring site near Bandelier National Monument at TA-49.
[c] State standard.
[d] Federal standard (NAAQS).
Source: DOE 2002d.

Criteria pollutant concentrations attributable to existing LANL activities were estimated for the *LANL SWEIS* and are presented in **Table 3–24**.

For toxic air pollutants, a bounding analysis was performed for the *LANL SWEIS*, which indicated that the pollutants of concern for exceeding the guideline values at LANL were emissions from the High Explosives Firing Site operations and emissions that contributed to additive risk from all TAs on receptors near the Los Alamos Medical Center. These combined cancer risks were dominated by the chloroform emissions from the Health Research Laboratory. It was shown that pollutants released under the No Action Alternative in the *LANL SWEIS* are not expected to cause air quality impacts that would affect human health and the environment (DOE 2002d).

In accordance with the Clean Air Act, as amended, and New Mexico regulations, the Bandelier National Monument and Wilderness Area has been designated as a Class I area (i.e., wilderness areas that exceed 4,047 hectares [10,000 acres]), where visibility is considered to be an important value (40 CFR 81 and 20 New Mexico Administrative Code 2.74) and requires protection. Visibility is measured according to a standard visual range, i.e., how far an image is transmitted through the atmosphere to an observer some distance away. Visibility has been officially monitored by the National Park Service at the Bandelier National Monument since 1988. The view distance at Bandelier National Monument has been recorded from approximately 127 to 182 kilometers (79 to 113 miles). The visual range has not deteriorated during the period for which data are available.

Table 3–24 Modeled Ambient Air Concentrations from Los Alamos National Laboratory Sources

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*Maximum Estimated Concentration* [b] *(micrograms per cubic meter)*
Criteria Pollutants			
Carbon monoxide	8 hours 1 hour	7,800 11,700	1,440 2,710
Lead	Calendar quarter	1.5	0.00007
Nitrogen dioxide	Annual 24 hours	73.7 147	9 90
PM_{10}	Annual 24 hours	50 150	1 9
Sulfur dioxide	Annual 24 hours 3 hours	41 205 1,030	18 130 254
Other regulated pollutants			
Total suspended particulates	Annual 24 hours	60 150	2 18

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million (ppm). These values have been converted to micrograms per cubic meter with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 2,135 meters [7,005 feet], following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] Based on the Expanded Operations Alternative in the *LANL SWEIS*. The annual concentrations were analyzed at locations to which the public has access – the site boundary or nearby sensitive areas. Short-term concentrations were analyzed at the site boundary and at the fence line of certain TAs to which the public has short access.

Source: DOE 2002d.

Radiological Releases

Radiological air emissions in 2003 from all LANL TAs combined are presented in **Table 3–25**. Radiological air emissions from TA-55 are also shown in the table.

3.3.5.2 Noise

Existing LANL-related publicly detectable noise levels are generated by a variety of sources, including truck and automobile movements to and from the LANL TAs, high explosives testing, and security guards' firearms practice activities. Noise levels within Los Alamos County unrelated to LANL are generated predominately by traffic movements and, to a much lesser degree, other residential-, commercial-, and industrial-related activities within local communities and the surrounding areas. Limited data currently exist on the levels of routine background ambient noise levels, air blasts, or ground vibrations produced by LANL operations that include explosives detonations.

Background noise levels were found to range from 31 to 35 dBA at the vicinity of the entrance to Bandelier National Monument and New Mexico Route 4 (NM 4). At White Rock, background noise levels range from 38 to 51 dBA (1-hour equivalent sound level); this is slightly higher than was found near Bandelier National Monument, probably due to higher levels of traffic and the presence of a residential neighborhood, as well as the different physical setting. The detonation of high explosives represents the peak noise level generated by LANL operations. The results of these detonations are air blasts and ground vibrations.

Table 3–25 Airborne Radioactive Emissions from Los Alamos National Laboratory in 2003

Radionuclide	*TA-55 (curies)*	*Other Areas (curies)*	*Total (curies)*
Tritium [a]	6.02×10^{1}	1.32×10^{3}	1.38×10^{3}
Americium-241 [b]	5.85×10^{-7}	3.12×10^{-7}	8.97×10^{-7}
Plutonium [b]	1.55×10^{-6}	3.32×10^{-6}	4.87×10^{-6}
Uranium [c]	–	7.09×10^{-6}	7.09×10^{-6}
Thorium [d]	3.90×10^{-8}	6.98×10^{-7}	7.37×10^{-7}
P/VAP [e]	–	6.04×10^{0}	6.04×10^{0}
G/Map [f]	–	7.39×10^{2}	7.39×10^{2}
Strontium-90	5.62×10^{-8}	2.14×10^{-7}	2.70×10^{-7}

[a] Includes both gaseous and oxide forms of tritium.
[b] Includes plutonium-238, -239, and -240.
[c] Includes uranium-234, -235, and -238.
[d] Includes thorium-228, -230, and -232.
[e] Particular/vapor activation products.
[f] Gaseous/mixed activation products.
Note: Dashed lines indicate virtually no releases.
Source: LANL 2004c.

The primary source of these detonation activities is the high explosives experiments conducted at the LANL Pulsed High-Energy Radiation Machine Emitting X-Rays Facility and surrounding TAs with active firing sites. In July 1999, with the appropriate DOE authorization, the Dual Axis Radiographic Hydrodynamic Test (DARHT) Project Office initiated DARHT facility operations on the DARHT first axis. Testing has continued since the late fall of 2000, when the first major hydrotest using the DARHT first axis was completed. As part of the *DARHT Mitigation Action Plan*, LANL has undertaken a long-term monitoring program at the ancestral Pueblo of Nake'muu to assess the impact of these LANL mission activities on cultural resources. Nake'muu is the only Pueblo at the Laboratory that still contains its original standing walls. It dates from circa A.D. 1200 to 1325 and contains 55 rooms with walls standing up to 6 feet high. Over the 6-year monitoring program, the site has witnessed a 0.6 percent displacement rate of chinking stones and 0.2 percent displacement of masonry blocks. The annual loss rate ranges from 0.5 to 2.0 percent for chinking stones and 0.05 to 1.3 percent for the masonry blocks. Statistical analyses indicate that these displacement rates are significantly correlated with annual snowfall, but not with annual rainfall or shots from the DARHT facility (LANL 2004a).

Air blasts consist of higher-frequency, audible air pressure waves that accompany an explosives detonation. This noise can be heard by both workers and the area public. The lower-frequency air pressure waves are not audible, but may cause secondary and audible noises within a testing structure that may be heard by workers. Air blasts and most LANL-generated ground vibrations result from testing activities involving aboveground explosives research. The effects of vibration from existing activities at LANL are discussed further in the *LANL SWEIS*.

The forested condition of much of LANL (especially where explosives testing areas are located), the prevailing area atmospheric conditions, and the regional topography that consists of widely varied elevations and rock formations all influence how noise and vibrations can be both attenuated (lessened) and channeled away from receptors. These regional features are jointly responsible for mitigating environmental noise pollution and ground vibration concerns in the area resulting from LANL operations.

Loss of large forest areas from the Cerro Grande Fire in 2000 has had an adverse effect on the ability of the surrounding environment to absorb noise. However, types of noise and noise levels associated with

LANL and from activities in surrounding communities have not changed significantly as a result of the fire (DOE 2000d).

Noise generated by LANL operations, together with the audible portions of explosives air blasts, is regulated by county ordinance and worker protection standards. The standard unit used to report sound pressure levels is the decibel (dB); the A-weighted frequency scale (dBA) is an expression of adjusted pressure levels by frequency that accounts for human perception of loudness. Los Alamos County has promulgated a local noise ordinance that establishes noise level limits for residential land uses. Noise levels that affect residential receptors are limited to a maximum of 65 dBA during daytime hours (between 7 a.m. and 9 p.m.) and 53 dBA during nighttime hours (between 9 p.m. and 7 a.m.). Between 7 a.m. and 9 p.m., the permissible noise level can be increased to 75 dBA in residential areas, provided the noise is limited to 10 minutes in any 1 hour.

The vigor and well being of area wildlife and sensitive, federally-protected bird populations suggest that noise levels are within an acceptable tolerance range for most wildlife species and sensitive nesting birds found along the Pajarito Plateau.

3.3.6 Ecological Resources

3.3.6.1 Terrestrial Resources

LANL lies within the Colorado Plateau Province. Ecosystems within the laboratory site itself are quite diverse, due partly to the 1,525-meter (5,000-foot) elevational gradient from the Rio Grande on the southeastern boundary to the Jemez Mountains, 20 kilometers (12.4 miles) to the west, and to the many canyons with abrupt slope changes that dissect the site. Only a small portion of the total land area at LANL has been developed, and only 5 percent of the site is estimated to be unavailable to most wildlife (because of security fencing). The remaining land has been classified into four major vegetation zones, which are defined by the dominant plants present and occur within specific elevational zones. These include mixed conifer forest, ponderosa pine forest, piñon-juniper woodland, and juniper savannah (see **Figure 3–16**). The vegetative communities on and near LANL are very diverse, with over 900 species of vascular plants identified in the area. As noted in Section 3.3.1.1, the 405-hectare (1,000-acre) White Rock Canyon Wildlife Reserve, located in the southeast perimeter of LANL, was dedicated in 1999 because of its ecological and cultural resources and research potential (DOE 2002d).

Terrestrial animals associated with vegetation zones in the LANL area include 57 species of mammals, 200 species of birds, 28 species of reptiles, and 9 species of amphibians. Common animals found on LANL include the collared lizard (*Crotaphytus collaris*), eastern fence lizard (*Sceloporus undulates*), black-headed grosbeak (*Pheucticus melanocephalus*), western bluebird (*Sialia mexicana*), elk, and raccoon (*Procyon lotor*). The most important and prevalent big game species at LANL are mule deer and elk. Elk populations have increased in the area from 86 introduced animals in 1948 and 1964 to an estimated population of over 10,000 animals. Hunting is not permitted onsite. Numerous raptors, such as the red-tailed hawk (*Buteo jamaicensis*) and great-horned owl (*Bubo virginianus*), and carnivores, such as the black bear (*Ursus americanus*) and bobcat (*Lynx rufus*), and great-horned owl, are also found on LANL. A variety of migratory birds have been recorded at the site (DOE 2002d).

In 2000, the Cerro Grande Fire burned approximately 17,400 hectares (43,000 acres), including about 3,035 hectares (7,500 acres) on LANL (LANL 2004a). Direct impacts on terrestrial resources included reduction in the habitat and loss of wildlife (DOE 2000d). Fire mitigation work, such as flood retention facilities, affected about 20 hectares (50 acres) of undeveloped land (LANL 2004b). Additionally,

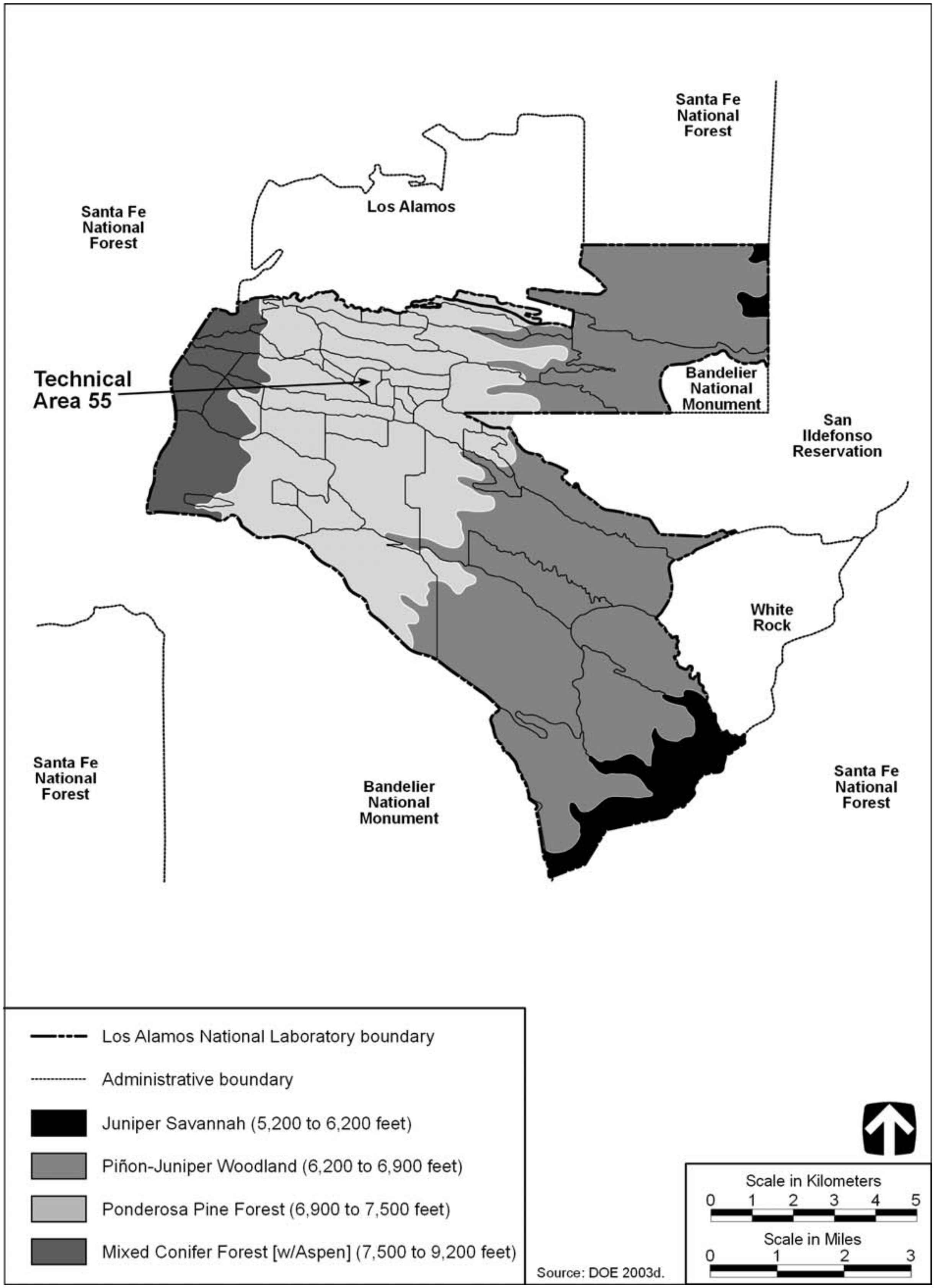

Figure 3–16 Los Alamos National Laboratory Vegetation Zones

2,947 hectares (7,283 acres) of forest have been thinned to reduce future wildfire potential (LANL 2005). Thinning also creates a forest that appears more park-like, with an increase in the diversity of shrubs, herbs, and grasses in the understory (LANL 2001b).

Within 2 years of the Cerro Grande Fire, a bark beetle outbreak occurred that resulted in 14 to 97 percent mortality in pine trees on 3,619 hectares (8,943 acres) of forest land. The infestation could result in an increase in runoff, herbaceous growth, and the potential for wildfire. It would also be expected to impact wildlife populations. While at least partially the result of the fire, the bark beetle outbreak appears to be more a consequence of stress resulting from current drought conditions (LANL 2005).

As noted in Section 3.3.1.1, 894 hectares (2,209 acres) have been conveyed to Los Alamos County or transferred to the Pueblo of San Ildefonso (LANL 2004a). Much of this land is in a natural state and falls within the piñon-juniper woodland and ponderosa pine forest zones. To date, none of this land has been developed, although development in the future could result in both direct and indirect impacts to terrestrial habitats and species.

TA-55 is located in the ponderosa pine forest vegetation zone; however, 43 percent of the site is developed. Animal species likely to be present in the area include the prairie lizard (*Sceloporus undulates*), white-breasted nuthatch (*Sitta carolinensis*), Audubon's warbler (*Dendroica coronata*), deer mouse (*Peromyscus maniculatus*), and raccoon. Due to the presence of security fencing, no large animals would be found within developed portions of TA-55 (DOE 2002d).

3.3.6.2 Wetlands

A total of 20 hectares (50 acres) of wetlands have been identified within LANL boundaries. Ninety-five percent of these are located in Sandia, Mortandad, Pajarito, and Water Canyon watersheds. The majority of the wetlands in the LANL region are associated with canyon stream channels or are present on mountains or mesas as isolated meadows containing ponds or marshes, often in association with springs or seeps. Cochiti Lake and the area near the LANL Fenton Hill site (TA-57) support lake associated wetlands. There are also some springs within White Rock Canyon. Wetlands in the general LANL region provide habitat for reptiles, amphibians, and invertebrates, and potentially contribute to the overall habitat requirements of a number of protected and sensitive species (LANL 2004a, DOE 1999a).

Prior to 1999, 38 LANL NPDES outfalls supported 5.3 hectares (13 acres) of wetlands. The reduction in NPDES-permitted outfalls from 38 to 21 from 1999 to 2003 reduced this acreage. As a bounding case, it is estimated that 2.8 hectares (6.8 acres) of wetlands could be impacted; however, the actual reduction has not been verified (LANL 2003, 2005).

During the Cerro Grande Fire, 6.5 hectares (16 acres) of the wetlands on LANL were burned at a low or moderate intensity. No wetlands within LANL were severely burned. Some riparian areas along the drainages also burned during the fire; however, these are not wetlands and are not included in the total acres of wetland. In addition to direct impacts from the fire, wetlands could receive increased sediment from runoff. While small amounts of sediment from the burned areas would enhance wetland growth, large amounts of deposited sediment could permanently alter the condition of existing wetlands and destroy them. The effects of the Cerro Grande Fire on LANL wetlands have not yet been fully assessed (DOE 2000f).

To date, all or portions of seven tracts have been conveyed or transferred to Los Alamos County and the Pueblo of San Ildefonso. These tracts contain a total of about 3.6 hectares (9 acres) of wetlands, including linear features (i.e., streams within canyons). Although these wetlands are no longer under the control of DOE, they are still protected by state and Federal regulations, and any potential impacts to them from the Proposed Action and alternatives are addressed in this *Consolidation EIS*. To date, there has been no change in the status of these wetlands since development has not taken place; however, future development could result in direct loss of wetland structure and function with a potential increase in downstream and offsite sedimentation (DOE 1999f).

There are three wetlands located within TA-55. These wetlands result from natural sources and are characterized by riparian vegetation. Wetland plant species present include rush (*Juncus spp.*), willow, and broad-leafed cattail (*Typha latifolia*). Animals observed using this wetland include the many-lined skink (*Eumeces multivigratus*), western chorus frog (*Pseudacris triseriata*), red-winged blackbird (*Agelaius phoeniceus*), violet-green swallow (*Tachycineta thalassiana*), long-tailed vole (*Microtus longicaudus*), and vagrant shrew (*Sorex vagrans*) (DOE 2002d).

3.3.6.3 Aquatic Resources

The watersheds draining the Jemez Mountains and the Pajarito Plateau are tributary to the Rio Grande, the fifth largest watershed in North America. Approximately 18 kilometers (11 miles) of LANL's eastern boundary borders on the rim of White Rock Canyon or descends to the Rio Grande. The riverine, lake, and canyon environment of the Rio Grande, as it flows through White Rock Canyon, makes a major contribution to the biological resources and significantly influences ecological processes of the LANL region. The relatively recent construction of Cochiti Dam at the mouth of White Rock Canyon for flood and sediment control, recreation, and fish and wildlife purposes has significantly changed the features of White Rock Canyon and introduced new ecological components and processes. Twelve species of fish (primarily found in the Rio Grande, Cochiti Lake, and the Rito de los Frijoles) have been identified in the LANL region (DOE 1999a, LANL 2004a).

While the Rio Grande and Rito de los Frijoles in Bandelier National Monument are the only truly perennial streams in the region, many canyon floors contain reaches of perennial surface water, such as the streams draining LANL property from lower Pajarito and Ancho Canyons to the Rio Grande. No fish species have been found within LANL boundaries (DOE 1999a, LANL 2004a).

There are no aquatic resources located within TA-55.

3.3.6.4 Threatened and Endangered Species

A number of threatened, endangered, and other special status species have been documented on LANL (**Table 3-26**). Federally-listed wildlife includes 2 endangered species, 2 threatened species, 1 candidate, and 8 species of concern. New Mexico protected and sensitive plants and animals include 3 endangered species, 7 threatened species, 2 species of concern, and 14 sensitive species. Additionally, 18 species of birds are listed as birds of conservation concern. DOE and LANL coordinate with the New Mexico Department of Game and Fish and the USFWS to locate and conserve protected and sensitive species (DOE 1999a).

Habitat that is either occupied by federally-protected species or that is potentially suitable for future use by these species has been delineated within LANL. The *Los Alamos Threatened and Endangered Species Habitat Management Plan*, implemented in 1998, identifies areas of environmental interest (AEI) for various federally-listed threatened or endangered species. In general, an AEI consists of a core area that contains important breeding or wintering habitat for a specific species and a buffer area around the core area. The buffer protects the core area from disturbances that would degrade its value. AEIs have been established for the Mexican spotted owl (S*trix occidentalis lucida*), bald eagle, and southwestern willow flycatcher (LANL 1998). They have not been established for the black-footed ferret (*Mustella nigripes*) since suitable habitat for this species does not occur at LANL (DOE 2003d).

Table 3–26 Protected and Sensitive Species of Los Alamos National Laboratory

Common Name	***Scientific Name***	***Status***	
		Federal	***State***
Plants			
Sapello Canyon larkspur	*Delphinium sapellonis*		Species of Concern
Springer's blazing star	*Mentzelia springeri*		Species of Concern
Wood lily (mountain lily)	*Lilium philadelphicum L. var. anadinum* (Nutt.) Ker		Endangered
Yellow lady's slipper orchid	*Cyprepedium calceolus L. var. pubescens* (Willd.) Correll		Endangered
Insects			
New Mexico silverspot butterfly	*Speyeria nokomis nitocris*	Species of Concern	
Fish			
Rio Grande chub	*Gila Pandora*		Sensitive
Amphibians			
Jemez Mountain salamander	*Plethodon neomexicanus*	Species of Concern	Threatened
Birds			
American peregrine falcon	*Falco peregrinus anatum*	Species of Concern, Conservation Concern	Threatened
Arctic peregrine falcon	*Falco peregrinus tundrius*	Species of Concern, Conservation Concern	Threatened
Bald eagle		Threatened	Threatened
Bendire's thrasher	*Toxostoma bendirei*	Conservation Concern	
Black-throated gray warbler	*Dendroica nigrescens*	Conservation Concern	
Crissal thrasher	*Toxostoma crissale*	Conservation Concern	
Feruginous hawk	*Buteo regalis*	Conservation Concern	
Flammulated owl	*Otus flammeolus*	Conservation Concern	
Graces's warbler	*Dendroica graciae*	Conservation Concern	
Golden eagle	*Aquila chrysaetos*	Conservation Concern	
Gray vireo	*Vireo vicinior*	Conservation Concern	Threatened
Lewis's woodpecker	*Melanerpes lewis*	Conservation Concern	
Loggerhead shrike	*Lanius ludovicianus*		Sensitive
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Sensitive
Northern goshawk	*Accipiter gentiles*	Species of Concern	Sensitive
Northern harrier	*Circus cyaneus*	Conservation Concern	
Piñon jay	*Gymnorhinus cyanocephalus*	Conservation Concern	
Prairie falcon	*Falco mexicanus*	Conservation Concern	
Sage sparrow	*Amphispiza belli*	Conservation Concern	
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered
Virginia's warbler	*Vermivora virginiae*	Conservation Concern	
Williamson's sapsucker	*Sphyrapicus thyroideus*	Conservation Concern	
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate, Conservation Concern	Sensitive
Mammals			
Big free-tailed bat	*Nyctinomops macrotis*		Sensitive

Common Name	***Scientific Name***	***Status***	
		Federal	***State***
Black-footed ferret	*Mustella nigripes*	Endangered	
Fringed myotis	*Myotis thysanodes*		Sensitive
Goat Peak pika	*Ochotona princeps nigrescens*	Species of Concern	Sensitive
Long-eared myotis	*Myotis evotis*		Sensitive
Long-legged myotis	*Myotis volans*		Sensitive
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Species of Concern	Threatened
Ringtail	*Bassariscus astutus*		Sensitive
Spotted bat	*Euderma maculatum*		Threatened
Townsend's big-eared bat	*Plecotus townsendii*	Species of Concern	Sensitive
Western small-footed myotis	*Myotis ciliolabrum*		Sensitive
Yuma myotis	*Myotis yumanensis*		Sensitive

Federal:

Candidate: substantial information exists in USFWS files on biological vulnerability to support proposals to list as endangered or threatened.

Conservation Concern: migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act.

Endangered: in danger of extinction throughout all or a significant portion of its range.

Species of Concern: conservation standing is of concern, but status information is still needed; they do not receive recognition under the Endangered Species Act.

Threatened: likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

State:

Endangered:
- *Animal*: any species or subspecies whose prospects of survival or recruitment in New Mexico are in jeopardy.
- *Plant*, a taxon listed as threatened or endangered under provision of the Federal Endangered Species Act, or is considered proposed under the tenets of the Act, or is a rare plant across its range within the state, and of such limited distribution and population size that unregulated taking could adversely impact it and jeopardize its survival in Mexico.

Sensitive: those taxa that, in the opinion of a qualified New Mexico Department of Game and Fish biologist, deserve special consideration in management and planning, and are not listed as threatened or endangered by the state of New Mexico.

Species of Concern: a New Mexico plant species, which should be protected from land use impacts when possible because it is a unique and limited component of the regional floral.

Threatened:
- *Animal:* any species or subspecies that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range in New Mexico.
- *Plant:* New Mexico does not list plants as threatened.

Sources: LANL 2004a, NMNHP 2004, NMSF 2004, NMDGF 2004a, 2004b, USFWS 2002, 2004a, 2004b, NMAC 919.21.2.

The Cerro Grande Fire did not severely burn any of the AEIs on LANL, although many of the Mexican spotted owl AEIs received moderate- and low-severity burns. Habitat within the southwestern willow flycatcher AEI and bald eagle AEI did not burn (DOE 2000f). There is no evidence that the fire caused a long-term change to the overall number of federally-listed threatened or endangered species inhabiting the region. LANL's species of greatest concern, the Mexican spotted owl, resumed normal breeding activities in 2001 and 2002. Some state-listed species, including the Jemez Mountain salamander, are likely to have been less fortunate (DOE 2003d).

As noted in Section 3.3.1.1, 894 hectares (2,209 acres) have been conveyed to Los Alamos County and transferred to the Pueblo of San Ildefonso. Some of the areas that have been turned over to these two entities have AEIs for both the Mexican spotted owl and peregrine falcon. However, the *LANL Threatened and Endangered Species Habitat Management Plan*, under which the AEIs are designated, is no longer in effect on conveyed or transferred land. Although none of the land has been developed to date, future development could result in the modification of habitat for protected and sensitive species (DOE 1999f).

There are three wetland locations within TA-55. Threatened and endangered species and species of concern associated with this type of wetland and which may be found in the vicinity include the Northern goshawk which is listed as a species of concern, the federally-threatened Mexican spotted owl, the state-threatened spotted bat, and the federally-endangered southwestern willow flycatcher (DOE 2002d). In addition, TA-55 contains core and buffer AEIs for the Mexican spotted owl.

3.3.7 Cultural Resources

3.3.7.1 Prehistoric Resources

Prehistoric resources at LANL refer to any material remains and items used or modified by people before the establishment of a European presence in the upper Rio Grande Valley in the early seventeenth century. Archaeological surveys have been conducted of approximately 90 percent of the land within LANL (with 85 percent of the area surveyed receiving 100 percent coverage) to identify the cultural resources. The majority of these surveys emphasized prehistoric American Indian archaeological sites, including pueblos, rock shelters, rock art, water control features, trails, and game traps. A total of 1,777 prehistoric sites have been recorded at LANL, of which 439 have been assessed for potential nomination to the National Register of Historic Places. Of these, 379 sites were determined to be eligible, 60 sites ineligible, and 2 of undetermined status. The remaining 1,338 sites, which have not been assessed for nomination to the National Register of Historic Places, are assumed to be eligible until assessed. Three areas in the vicinity of LANL have been established as National Register of Historic Places sites or districts: Bandelier National Monument, Puye Cliffs Historic Ruins, and the Los Alamos Scientific Laboratory National Historic District. The latter is the location of former TA-1 in downtown Los Alamos, which includes Fuller Lodge, the Bathtub Row Houses, and the Ice House Monument at Ashley Pond.

The Cerro Grande Fire directly impacted 215 prehistoric sites. Effects on cultural resource sites included those originating from burned-out tree root systems forming conduits for modern debris and water to mix with subsurface archaeological deposits and for entry by burrowing animals. Also, snags or dead or dying trees have fallen and uprooted artifacts (DOE 2000d). Additionally, the leveling of a staging area in TA-49 during the fire destroyed one and damaged two other prehistoric sites. Areas at LANL burned by the Cerro Grande Fire have been surveyed for impacts, and mitigation measures have been implemented.

A single paleontological artifact has been discovered at a site within LANL boundaries; however, in general the near-surface stratigraphy is not conducive to preserving plant and animal remains. The near-surface materials at LANL are volcanic ash and pumice that were extremely hot when deposited; most carbon-based materials (such as bones or plant remains) would likely have been vaporized or burned if present.

TA-55 contains no prehistoric or paleontological sites. Within TA-48, a short distance from the TA-55 boundary (about 100 meters [300 feet]), there is a prehistoric site eligible for listing on the National Register of Historic Places (DOE 2003d).

3.3.7.2 Historic Resources

In April 2000, the DOE entered into a programmatic agreement with the New Mexico State Historic Preservation Office concerning the management of LANL's historic properties (MOU DE-GM32-00AL77152). Historic resources present within LANL boundaries and on the Pajarito Plateau can be attributed to nine locally defined Periods: U.S. Territorial, Statehood, Homestead, Post Homestead, Historic Pueblo, Undetermined Historic, Manhattan Project, Early Cold War, and Late Cold War. The number of sites identified from each period are as follows: 1 from the U.S. Territorial Period, 9 from the Statehood Period, 71 from the Homestead Period, 5 from the Post Homestead Period, 1 from the Historic Pueblo Period, 36 from the Undetermined Historic Period, 56 from the Manhattan Project Period, and 527 from the Early and Late Cold War Periods. Thus, a total of 706 historic sites have been identified at LANL (DOE 2003d).

The Cerro Grande Fire directly impacted 11 historic buildings and 56 historic sites. Structures and artifacts from the Homestead Period, Manhattan Project Period, and Cold War Period were adversely affected. The fire destroyed virtually all-wooden buildings associated with the Homestead Period, and the burned properties were largely reduced to rubble. V-Site, one of the last vestiges of the Manhattan Project Period remaining at Los Alamos, was the location where work was conducted on the Trinity device. This important historical site was partially destroyed by the fire. Also, a historic structure and building at TA-2 were adversely impacted by post-fire activities (DOE 2000d).

TA-55 contains 11 historic resources. The New Mexico State Historic Preservation Office has concurred with the determination that 1 is eligible for the National Register of Historic Places, and 2 have been determined to be not eligible. The remaining eight have yet to be assessed (DOE 2003d).

3.3.7.3 Traditional Cultural Properties

Consultations to identify traditional cultural properties were conducted with 19 American Indian tribes in connection with the preparation of the *LANL SWEIS*. Two Hispanic communities were also contacted. These consultations identified 15 ceremonial and archaeological sites, 14 natural features, 10 ethnobotanical sites, 7 artisan material sites, and 8 subsistence features. In addition to physical cultural entities, concern has been expressed that “spiritual,” “unseen,” “undocumentable,” or “beingness” aspects can be present at LANL that are an important part of American Indian culture and may be adversely impacted by LANL’s presence and operation. Additional consultations regarding traditional cultural properties are ongoing for LANL and other nearby DOE-administered properties (DOE 2003d).

3.3.8 Socioeconomics

Statistics for population, housing, and local transportation are presented in this section for the region of influence, a three-county area in New Mexico in which 89.2 percent of all LANL employees reside (see **Table 3–27**). In 2003, LANL employed 12,975 persons in New Mexico (LANL 2004a).

Table 3–27 Distribution of Employees by Place of Residence in the Los Alamos National Laboratory Region of Influence in 2003

County	*Number of Employees*	*Total Site Employment (percent)*
Los Alamos	5,800	44.7
Rio Arriba	2,898	22.3
Santa Fe	2,876	22.2
Region of influence total	11,574	89.2

Source: LANL 2004a.

3.3.8.1 Regional Economic Characteristics

Between 2000 and 2003, the average annual civilian labor force in the Tri-County area increased 7.1 percent to the 2003 level of 104,124. In 2003, the annual average unemployment rate in the region of influence was 4.4 percent, which was less than the annual unemployment average of 6.4 percent for New Mexico (NM DOL 2004).

In 2003, Government represented the largest sector of employment in the Tri-County area (29.8 percent). This was followed by trade, utilities, and transportation activities (15.4 percent) and leisure and hospitality (12.8 percent) (NM DOL 2005). The totals for these employment categories in New Mexico were 23.4 percent, 18.0 percent, and 11.0 percent, respectively (BBER 2004).

3.3.8.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 3–28**. Persons self-designated as minority individuals comprise 57.9 percent of the total population. This minority population is composed largely of Hispanic or Latino and American Indian residents. The Pueblos of San Ildefonso, Santa Clara, San Juan, Nambe, Pojoaque, Tesuque, and part of the Jicarilla Apache Indian Reservation are included in the region of influence.

Table 3–28 Demographic Profile of the Population in the Los Alamos National Laboratory Region of Influence

	Los Alamos County	*Rio Arriba County*	*Santa Fe County*	*Region of Influence*
Population				
2000 population	18,343	41,190	129,292	188,825
1990 population	18,115	34,365	98,928	151,408
Percent change from 1990 to 2000	1.3	19.9	30.7	24.7
Race (2000) (percent of total population)				
White	90.3	56.6	73.5	71.5
Black or African American	0.4	0.3	0.6	0.5
American Indian and Alaska Native	0.6	13.9	3.1	5.2
Asian	3.8	0.1	0.9	1.0
Native Hawaiian and Other Pacific Islander	0.0	0.1	0.1	0.1
Some other race	2.7	25.6	17.7	18.0
Two or more races	2.3	3.3	4.1	3.7
Percent minority	17.9	86.4	54.5	57.9
Ethnicity (2000)				
Hispanic or Latino	2,155	30,025	63,405	95,585
Percent of total population	11.7	72.9	49.0	50.6

Source: DOC 2005.

Income information for the LANL region of influence is included in **Table 3–29**. There are significant differences in the income levels among the three counties, especially between Rio Arriba County at the low end with a median household income of $29,429 and Los Alamos County at the upper end with a medial household income of $78,993. The median household income in Los Alamos County is over twice that of the New Mexico state average. In 2000, only 2.9 percent of the population in Los Alamos County was below the official poverty level compared with 20.3 percent of the population of Rio Arriba County.

Table 3–29 Income Information for the Los Alamos National Laboratory Region of Influence

	Los Alamos County	*Rio Arriba County*	*Santa Fe County*	*New Mexico*
Median household income 2000 (dollars)	78,993	29,429	42,207	34,133
Percent of persons below poverty line (2000)	2.9	20.3	12.0	18.4

Source: DOC 2005.

3.3.8.3 Housing

Table 3–30 lists the total number of occupied housing units and vacancy rates in the region of influence. In 2000, there were a total of 83,654 housing units in the Tri-County area, with 89.7 percent occupied and 10.3 percent vacant. The median value of owner-occupied homes in Los Alamos County ($238,300) was the greatest of the three counties, and over twice the median value of owner occupied homes in Rio Arriba County ($107,500). The vacancy rate was the smallest in Los Alamos County (5.5 percent) and highest in Rio Arriba County (16.5 percent). During the Cerro Grande Fire, approximately 230 housing units were destroyed or damaged in the northern portions of Los Alamos County (DOE 2000d) and, as a result, vacancy rates have decreased.

Table 3–30 Housing in the Los Alamos National Laboratory Region of Influence

	Los Alamos County	*Rio Arriba County*	*Santa Fe County*	*Region of Influence*
Housing (2000)				
Total units	7,937	18,016	57,701	83,654
Occupied housing units	7,497	15,044	52,482	75,023
Vacant units	440	2,972	5,219	8,631
Vacancy Rate (percent)	5.5	16.5	9.0	10.3
Median value (dollars)	228,300	107,500	189,400	175,067

Source: DOC 2005.

3.3.8.4 Local Transportation

Motor vehicles are the primary means of transportation to LANL. Regional transportation route(s) connecting LANL to Albuquerque and Santa Fe are I–25 to U.S. 84/285 to NM 502; to Española are NM 30 to NM 502; and to Jemez Springs and western communities is NM 4. Hazardous and radioactive material shipments leave or enter LANL from East Jemez Road to NM 4 to NM 502 (see Figures 3–10 and 3–11). Only two major roads, NM 502 and NM 4, access Los Alamos County. Los Alamos County traffic volume on these two segments of highway is primarily associated with LANL activities.

A public bus service located in Los Alamos operates within Los Alamos County. The Los Alamos bus system consists of seven buses that operate five days a week. The nearest commercial bus terminal is located in Santa Fe, New Mexico. The nearest commercial rail connection is at Lamy, New Mexico, 83 kilometers (52 miles) southeast of LANL. LANL does not currently use rail for commercial shipments. The primary commercial international airport in New Mexico is located in Albuquerque. The small Los Alamos County Airport is owned by the Federal Government, and operations and maintenance are performed by Los Alamos County. The airport is located parallel to East Road at the southern edge of the Los Alamos community. Until January 1996, the airport provided regular passenger and cargo service through specialized contract carriers such as Ross Aviation, which were under contract with DOE to provide passenger and cargo air service to Los Alamos County and LANL. DOE continues to negotiate with various companies to provide for service to the Los Alamos Airport.

3.3.9 Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposure to ionizing radiation and hazardous chemicals.

3.3.9.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of LANL are shown in **Table 3–31**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to LANL operations.

Table 3–31 Sources of Radiation Exposure to Individuals in the Los Alamos National Laboratory Vicinity Unrelated to Los Alamos National Laboratory Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
Total external (cosmic and terrestrial) [a]	120
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	425

[a] LANL 2000b.
[b] NCRP 1987.
[c] An average for the United States.

Releases of radionuclides to the environment from LANL operations provide another source of radiation exposure to individuals in the vicinity of LANL. Types and quantities of radionuclides released from LANL operations in 2003 are listed in *Environmental Surveillance at Los Alamos During 2003* (LANL 2004c). The releases are summarized in Section 3.3.5.1 of this EIS. The doses to the public resulting from these releases are presented in **Table 3–32**. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those from background radiation.

Using a risk estimator of 6.0×10^{-4} LCF per rem (see Appendix C of this EIS), the fatal cancer risk to the maximally exposed offsite member of the public due to radiological releases from LANL operations is estimated to be 3.75×10^{-7}. The estimated probability of this maximally exposed person dying of cancer at some point in the future from radiation exposure associated with 1 year of LANL operations is less than one in 2.7 million (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

Table 3–32 Radiation Doses to the Public from Normal Los Alamos National Laboratory Operations in 2003 (total effective dose equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard [a]	Actual	Standard [a]	Actual	Standard [a]	Actual
Maximally exposed offsite individual (millirem)	10	0.625	4	~0	100	0.625
Population within 80 kilometers (50 miles) (person-rem) [b]	None	0.88	None	~0	100	0.88
Average individual within 80 kilometers (50 miles) (millirem) [c]	None	0.0031	None	~0	None	0.0031

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem-per-year limit from airborne emissions is required by the Clean Air Act (40 CFR 61) and the 4-millirem-per-year limit is required by the Safe Drinking Water Act (40 CFR 141). For this *Consolidation EIS*, the 4-millirem-per-year value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, *Radiation Protection of the Public and the Environment: Proposed Rule,* as published in 58 FR 16268. If the potential total dose exceeds the 100-person-rem value, the contractor operating the facility would be required to notify DOE.
[b] About 280,000 based on county population estimates for 2003.
[c] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.
Source: LANL 2004c.

According to the same risk estimator, 3.75×10^{-4} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of LANL from normal operations in 2003. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 2003 from all causes in the population of 280,000 living within 80 kilometers (50 miles) of LANL would be 560. This expected number of fatal cancers is much higher than the fatal cancers estimated from LANL operations in 2003.

LANL workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at LANL from operations in 2003 are presented in **Table 3–33**. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of 6.0×10^{-4} LCF per person-rem (see Appendix C of this EIS), the number of projected fatal cancers among LANL workers from normal operations in 2003 is 0.14.

Table 3–33 Radiation Doses to Workers from Normal Los Alamos National Laboratory Operations in 2003 (total effective dose equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard [a]	Actual
Average radiation worker (millirem)	None [b]	117
Total workers [c] (person-rem)	None	240

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999f); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] No standard is specified for an average radiation worker; however, the maximum dose that this worker may receive is limited to that given in footnote (a).
[c] There were 2,047 workers with measurable doses in 2003.
Source: DOE 2003e.

3.3.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at LANL via inhalation of air containing hazardous chemicals released to the atmosphere by LANL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 3.3.5.1. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations.

Chemical exposure pathways to LANL workers during normal operations may include inhaling the workplace atmosphere, drinking LANL potable water, and possible other contact with hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LANL workers are also protected by adherence to the Occupational Safety and Health Administration and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at LANL are substantially better than required by standards.

3.3.9.3 Health Effects Studies

Numerous epidemiological studies have been conducted in the LANL area. One study conducted by the New Mexico Department of Health reported elevations in brain cancer incidence during the mid- to late-1980s, compared to state and national reference populations, but random fluctuation could not be ruled out. Breast cancer incidence rates in Los Alamos from 1970 to 1990 remained level, but higher than New Mexico rates. Reproductive and demographic factors known to increase the risk of breast cancer have been prevalent in Los Alamos County. Ovarian cancer incidence in the county from 1986 to 1990 was approximately twofold greater than that observed in a New Mexico State reference population. In the mid- to late-1980s, a twofold excess risk of melanoma was observed in Los Alamos County compared with a New Mexico State reference population. A more recent study observed a fourfold increase in thyroid cancer incidence during the late 1980s and early 1990s compared with the State as a whole, but the rate began to decline in 1994 and 1995. No statistically significant excess cancers were reported for male workers exposed to plutonium. However, statistically significant excesses in kidney cancer and lymphomatic leukemia were observed in male workers exposed to external radiation. For more detailed descriptions of studies reviewed and the findings, refer to Appendix D, Section D.1.2 of the *LANL SWEIS* (DOE 1999a) and to Appendix E, Section E.4.6 of the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (SSM PEIS),* DOE/EIS-0236 (DOE 1996c).

3.3.9.4 Accident History

Degradation of a radioactive material container occurred on August 5, 2003, at TA-55. A package containing residues from plutonium-238 operations breached while being handled by two workers performing a pre-inventory check. The pressurized release of materials from the package gave the workers uptake doses of two or three rem cumulative effective dose equivalents (LCF of 0.0012 to 0.0018).

On February 15, 2001, plutonium-238 was released into the air from a glovebox when the hot nuclear material caused a crack in a technician's uninsulated glove. The accident was partially a result of a failure to follow procedures for safely handling plutonium-238. DOE investigated allegations concerning this incident along with radiological incident reports from 1999 and 2000 at TA-55. As a result, recommendations were made, accepted by LANL and instituted in corrective actions at TA-55 (DOE 2003f).

In March 2000, a radiological release of plutonium-238 occurred near a glovebox in the Plutonium Facility at TA-55. Seven workers had confirmed intakes of plutonium-238. The source of the release was a compression fitting in a contaminated vacuum line serving the glovebox. After an investigation was completed, lessons learned from this incident were documented by DOE. As a result, LANL performed a check of over 50,000 mechanical fittings at TA-55 and corrected any leak problems (DOE 2000g).

None of the aforementioned plutonium-238 accidents resulted in any measurable radiological impacts to the public.

On May 4, 2000, the National Park Service at Bandelier National Monument set a prescribed fire that subsequently burned out of control. This Cerro Grande Fire damaged or destroyed more than 100 LANL structures and about 230 residential structures in the Los Alamos townsite. By the time it was contained, it had burned approximately 3,035 hectares (7,500 acres) within the boundaries of LANL. LANL is conducting an extensive environmental monitoring and sampling program to evaluate the effects of that fire at the laboratory and especially to evaluate if public and worker health and the environment were adversely impacted by the fire on Laboratory land. The program will identify changes from prefire baseline conditions that will aid in evaluating potential future impacts, especially those from any contaminants that may have been transported offsite (LANL 2000b).

3.3.9.5 Emergency Preparedness and Security

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, training, preparedness, and response. The LANL emergency management program was activated on May 5, 2000, to coordinate emergency management operations during the Cerro Grande Fire.

DOE maintains equipment and procedures to respond to situations where human health or the environment is threatened. These include specialized training and equipment for the local fire department, local hospitals, state public safety organizations, and other government entities that may participate in response actions, as well as specialized assistance teams (DOE Order 151.1, *Comprehensive Emergency Management System*). These programs also provide for notification of local governments whose constituencies may be threatened. Broad ranges of exercises are run to ensure the systems are working properly, from facility-specific exercises to regional responses. In addition, DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency responses to an accidental explosion at the Hanford Site in May 1997.

3.3.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. Minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income.

Figure 3–17 shows the relationship of TA-55 to surrounding Indian Reservations and the region of potential radiological impact. As shown in the figure, areas potentially at radiological risk from the current missions performed at TA-55 include the city of Santa Fe and several Pueblos and the Jicarilla Apache Reservation in North Central New Mexico. Eight counties are included or partially included in the potentially affected area (see **Figure 3–18)**: Bernalillo, Los Alamos, Mora, Rio Arriba, Sandoval, San Miguel, Santa Fe, and Taos. **Table 3–34** provides the total minority composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, a majority of these county residents designated themselves as members of a minority (54 percent of the total population of these counties). Hispanics and American Indians/Alaska Natives comprised over 91 percent of the minority population. As a percentage of the total resident population in 2000, New Mexico had the largest percentage minority population (55 percent) among the contiguous states and the second largest percentage minority population among all of the states (only Hawaii had a larger percentage minority population [77 percent]).

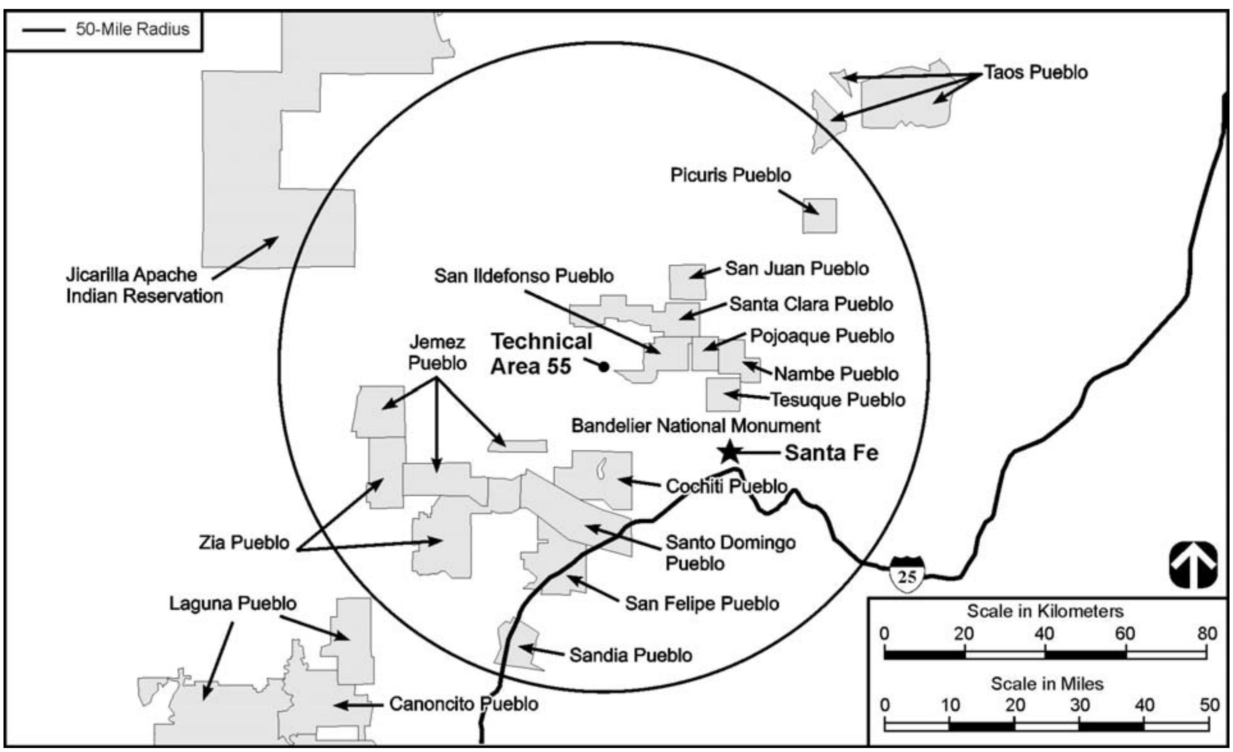

Figure 3–17 Location of Technical Area 55 and Indian Reservations Surrounding Los Alamos National Laboratory

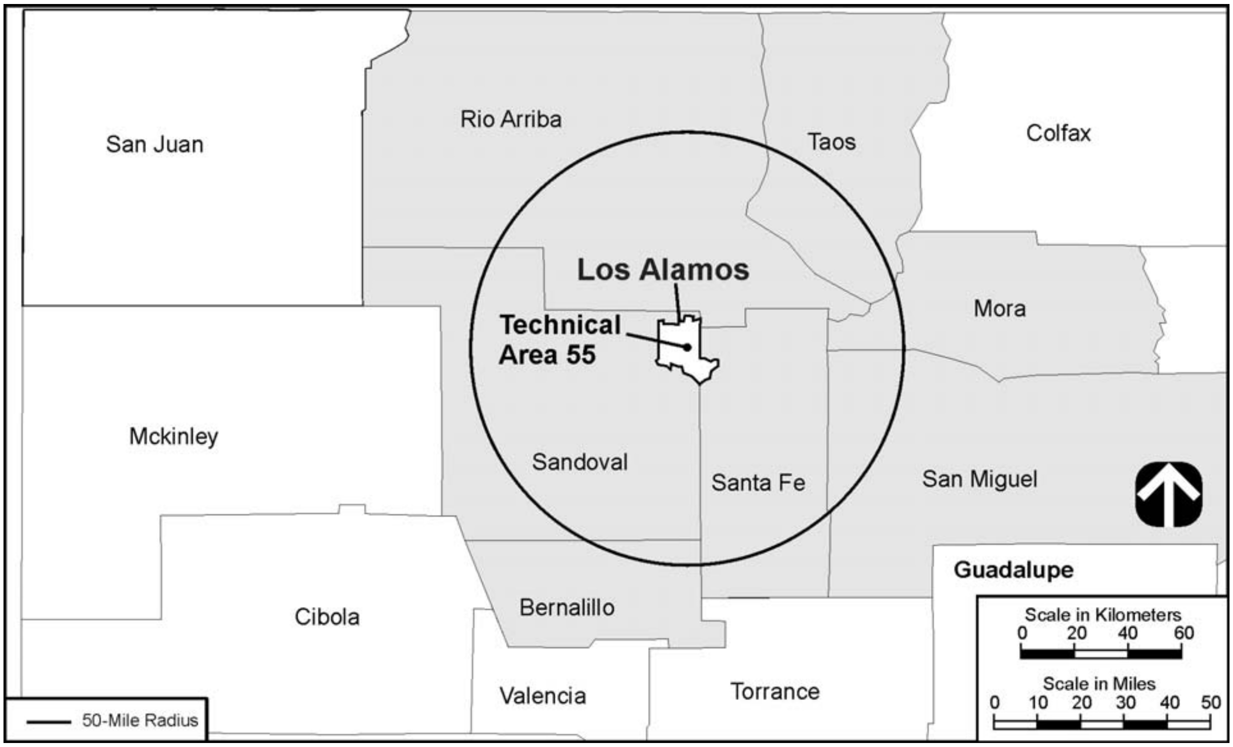

Figure 3–18 Potentially Affected Counties Surrounding Los Alamos National Laboratory

Table 3–34 Populations in Potentially Affected Counties Surrounding Los Alamos National Laboratory in 2000

Population Group	*Population*	*Percentage of Total*
Minority	490,172	54.4
Hispanic	400,725	44.5
Black or African American	15,945	1.8
American Indian and Alaska Native	44,468	4.9
Asian	12,188	1.4
Native Hawaiian and Pacific Islander	527	0.1
Two or more races	14,859	1.6
Some other race	1,460	0.2
White	410,524	45.6
Total	900,696	100.0

Source: DOC 2005.

The percentage of population for whom poverty status was determined in potentially affected counties in 2000 was approximately 13 percent. In 2000, nearly 18 percent of the total population of New Mexico reported incomes less than the poverty threshold. In terms of percentages, minority populations and low-income resident populations in 2000 in potentially impacted counties were lower than the state percentage.

3.3.11 Waste Management and Pollution Prevention

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies, and in compliance with all applicable Federal and State statutes and DOE Orders.

3.3.11.1 Waste Inventories and Activities

LANL manages the following types of waste: transuranic, mixed transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Waste generation rates and the inventory of stored waste from activities at LANL are provided in **Table 3–35**. Selected waste management facilities at LANL are summarized in **Table 3–36**.

Table 3–35 2003 Selected Waste Generation Rates and Inventories at Los Alamos National Laboratory

Waste Type	*Generation Rate (cubic meters per year)*	*Inventory (cubic meters)*
Transuranic	560 [a]	12,120
Low-level radioactive	5,625	Not applicable [b]
Mixed low-level radioactive	36	25 [c]
Hazardous (in metric tons)	689 [d]	Not applicable [b]
Nonhazardous		
Liquid	794,253	Not applicable [b]
Solid (in metric tons)	10,280 [e]	Not applicable [b]

[a] Includes 157 cubic meters of mixed transuranic waste.
[b] Generally, low-level radioactive, hazardous, and nonhazardous waste are not held in long-term storage.
[c] Inventory as of September 2004.
[d] This waste type also includes biomedical waste.
[e] 8,100 metric tons is recycled.
Notes: The generation rates are attributed to facility operations and do not include the waste generated from environmental restoration actions.
To convert from cubic meters to cubic yards, multiply by 1.3079.
Source: DOE 2002d, 2003d; LANL 2004b, 2005; SNL 2004.

3.3.11.2 Transuranic Waste

All projects generating transuranic waste at LANL are required to implement waste minimization procedures (64 FR 50797). As part of the implementation of the ROD for “Transuranic Waste Treatment and Storage,” part of the *Waste Management PEIS* (DOE 1997b), LANL will treat transuranic waste onsite to reduce volume as much as possible and to meet waste acceptance criteria for disposal at WIPP.

3.3.11.3 Low-Level Radioactive Waste

Solid low-level radioactive waste generated by LANL’s operating divisions is characterized and packaged for disposal at the onsite low-level radioactive waste disposal facility at TA-54, Area G. Low-level radioactive waste minimization strategies are intended to reduce the environmental impacts associated with low-level radioactive waste operations and waste disposal by reducing the amount of low-level radioactive waste generated and/or minimizing the volume of low-level radioactive waste that will require storage or disposal onsite (LANL 2000a).

Table 3–36 Selected Waste Management Facilities at Los Alamos National Laboratory

Facility Name/Description	*Capacity*	*Status*	*Applicable Waste Type*				
			TRU	*Low-Level Radioactive Waste*	*Mixed Low-Level Radioactive Waste*	*Hazardous*	*Non-hazardous*
Treatment Facility (cubic meters per year)							
TRU waste volume reduction	1,080	Online	X				
RAMROD and RANT Facilities	1,050	Online	X				
Low-level radioactive waste compaction	342	Online		X			
Sanitary wastewater treatment	1,060,063	Online					X
Radioactive Liquid Waste Treatment Facility	35,000,000 [a] liters	Online		X			
Storage Facility (cubic meters)							
TRU waste storage	14,090	Online	X				
Mixed low-level radioactive waste storage	1,515	Online			X		
Hazardous waste storage	260	Online				X	
Disposal Facility							
TA-54, Area G low-level radioactive waste disposal (cubic meters)	252,500 [b]	Online		X			
Sanitary tile fields (cubic meters per year)	567,750	Online					X

TRU = transuranic waste, RAMROD = Radioactive Materials Research, Operations, and Demonstration; RANT = Radioactive Assay and Nondestructive Test.

[a] Amount of radioactive liquid waste projected to be treated under the *LANL SWEIS* Expanded Operations Alternative.

[b] Current inventory of 250,000 cubic meters. Capacity will be expanded as part of implementation of the *LANL SWEIS* ROD.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079.

Source: DOE 2002d, 2003d; LANL 2005.

A 1998 analysis of the low-level radioactive waste landfill at TA-54, Area G, indicated that at previously planned rates of disposal, the disposal capacity would be exhausted in a few years. Reduction in low-level radioactive waste generation has extended this time to approximately 5 years; however, potentially large volumes of waste from planned construction upgrades could rapidly fill the remaining capacity (LANL 2000a).

As part of the implementation of the ROD in the *LANL SWEIS*, DOE will continue onsite disposal of LANL-generated low-level radioactive waste using the existing footprint at the Area G low-level waste disposal area and will expand disposal capacity into Zones 4 and 6 at Area G. This expansion would cover up to 29 hectares (72 acres). Additional sites for low-level radioactive waste disposal at Area G would provide onsite disposal for an additional 50 to 100 years (64 FR 50797, LANL 2000a).

Liquid low-level radioactive waste is transferred through a system of pipes and by tanker trucks to the RLWTF at TA-50, Building 1. The radioactive components are removed and disposed of as solid low-level radioactive waste at TA-54, Area G. The remaining liquid is discharged to a permitted outfall (LANL 2000a).

3.3.11.4 Mixed Low-Level Radioactive Waste

There are seven major mixed low-level radioactive waste streams at LANL: circuit boards, gloveboxes, lead parts, research and development chemicals, personal protective equipment, fluorescent tubes, and waste generated from spills and spill cleanup. Typically, mixed low-level radioactive waste is transferred to a satellite storage area once generated. Whenever possible, mixed low-level materials are surveyed to confirm the radiological contamination levels, and if decontamination will eliminate either the radiological or the hazardous component, materials are decontaminated and removed from the mixed low-level radioactive waste category (LANL 2000a).

Proper waste management and DOT documentation are provided for solid waste operations at TA-54, Area G or Area L, to process remaining mixed low-level radioactive waste for storage, bulking, and transportation. From TA-54, mixed low-level radioactive waste is sent to commercial and DOE treatment and disposal facilities. The waste is treated/disposed of by various processes (e.g., segregation of hazardous components, macroencapsulation, or incineration) (LANL 2000a).

In October 1995, the state of New Mexico issued a Federal Facility Compliance Order to both DOE and LANL requiring compliance with the site treatment plan. That plan documents the development of treatment capacities and technologies or use of offsite facilities for treating mixed waste generated at LANL that is stored beyond the 1-year timeframe (LANL 2000b).

3.3.11.5 Hazardous Waste

Most LANL activities generate some amount of hazardous waste. Hazardous waste commonly generated at LANL includes many types of laboratory research chemicals, solvents, acids, bases, carcinogens, compressed gases, metals, and other solid waste contaminated with hazardous waste. This may include equipment, containers, structures, and other items intended for disposal and contaminated with hazardous waste (e.g., compressed gas cylinders). After the hazardous waste is collected, it is sorted and segregated. Some materials are reused within LANL, and others are decontaminated for reuse. Those materials that cannot be decontaminated or recycled are packaged and shipped to offsite RCRA-permitted treatment and disposal facilities (LANL 2000a).

3.3.11.6 Nonhazardous Waste

Both LANL and Los Alamos County use the same landfill located within LANL boundaries. The landfill is operated under a special permit by Los Alamos County. The Los Alamos County Landfill received about 20 million kilograms (22,013 tons) of solid waste from all sources during the period July 1995 through June 1996, with LANL contributing about 22 percent of the solid waste. Since the Cerro Grande Fire, the generation of wastes from community and LANL cleanup activities has increased several fold. The Los Alamos County Landfill is scheduled for closure in 2006. A replacement facility, which would be located offsite, would then be used by LANL for nonhazardous waste disposal. It is currently anticipated that the replacement facility would be located within 160 kilometers (100 miles) of LANL. Both LANL and Los Alamos County would need to transport their wastes to the new facility.

Sanitary liquid waste is delivered by dedicated pipelines to the Sanitary Wastewater Systems Consolidation Plant at TA-46. The plant has a design capacity of 2.27 million liters (600,000 gallons) per day, and in 2000 processed a maximum of about 950,000 liters (250,000 gallons) per day. Some septic tank pumpings are delivered periodically to the plant for treatment via tanker truck. Sanitary waste is treated by an aerobic digestion process. After treatment, the liquid from this process is recycled to the TA-3 power plant for use in cooling towers or is discharged to Sandia Canyon adjacent to the power plant under an NPDES permit and groundwater discharge plan. Under normal operating conditions, the solids from this process are dried in beds at the Sanitary Wastewater Systems Consolidation Plant and are applied as fertilizer as authorized by the existing NPDES permit.

3.3.11.7 Waste Minimization

LANL's Environmental Stewardship Office manages LANL's pollution prevention program. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. Achievements and progress are updated at least annually. Implementing pollution prevention projects reduced the total amount of waste generated at LANL in 1999 by approximately 2,459 cubic meters (3,216 cubic yards). Examples of pollution prevention projects completed in 1999 at LANL include reduction of low-level radioactive waste and mixed low-level radioactive waste by 116 cubic meters (152 cubic yards) by decontaminating waste metal and reduction of transuranic waste by 3 cubic meters (4 cubic yards) by using improved nondestructive assay instrumentation, which enabled the measurement and characterization of waste as either transuranic or low-level radioactive waste (DOE 2000f).

3.3.11.8 *Waste Management PEIS* Records of Decision

The *Waste Management PEIS* RODs affecting LANL are shown in **Table 3–37**. Decisions on the various waste types were announced in a series of RODs published on the *Waste Management PEIS* (DOE 1997b). The initial transuranic waste ROD was issued on January 20, 1998 (63 FR 3629) with several subsequent amendments, the hazardous waste ROD was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste ROD was published on February 18, 2000 (65 FR 10061). The transuranic waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare transuranic waste for disposal at WIPP. Each DOE site that has or will generate transuranic waste will, as needed, prepare and store its transuranic waste onsite until the waste is shipped to WIPP. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own nonwastewater hazardous waste onsite in existing facilities, where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste ROD states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites, and disposal will continue, to the extent practicable, onsite at INL, LANL, ORR, and SRS. In addition, the Hanford Site and NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at the Hanford Site, INL, ORR, and SRS and disposed of at the Hanford Site and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at LANL is presented in the hazardous waste and the low-level radioactive and mixed low-level radioactive waste RODs.

3.3.12 Environmental Restoration Program

DOE is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at LANL. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

Table 3–37 Waste Management Programmatic Environmental Impact Statement Records of Decision Affecting Los Alamos National Laboratory

Waste Type	*Preferred Action*
Transuranic	Dispose at WIPP.
Low-level radioactive	DOE has decided to treat LANL low-level radioactive waste onsite and continue onsite disposal. [a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at the Hanford Site, INL, ORR, and SRS. DOE has decided to ship LANL mixed low-level radioactive waste to either the Hanford Site or NTS for disposal. [a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of most of LANL nonwastewater hazardous waste. [b]

[a] From the ROD for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[b] From the ROD for hazardous waste (63 FR 41810).
Source: 65 FR 10061, 63 FR 41810.

Although not listed on the National Priorities List, LANL adheres to CERCLA guidelines for environmental restoration projects that involve certain hazardous substances not covered by RCRA. LANL's environmental restoration program originally consisted of approximately 2,100 potential release sites (DOE 2002d). At the end of 1999, there remained 1,206 potential release sites requiring investigation or remediation and 118 buildings awaiting decontamination and decommissioning. Based on a review by LANL's Environmental Restoration Project, the boundary of Potential Release Site 48-001 overlaps a small area at TA-55. This area of overlap involves possible surface soil contamination from TA-48 stack emissions. Further investigation and any necessary remediation of this site will be completed under LANL's environmental restoration program (DOE 2002d) and in accordance with LANL's Hazardous Waste Facility Permit. More information on regulatory requirements for waste disposal is provided in Chapter 5 of this EIS.

3.4 Oak Ridge National Laboratory

ORNL is located within the ORR. ORR was established in 1943 as one of the three original Manhattan Project sites, is located on 13,949 hectares (34,424 acres) in Oak Ridge, Tennessee, and includes ORNL, the Y-12 Plant (Y-12), and the East Tennessee Technology Park (ETTP). It extends over parts of Anderson and Roane Counties. The primary focus of ORNL is to conduct basic and applied scientific research and technology development. Y-12 engages in national security activities and manufacturing outreach to U.S. industries. The mission of the ETTP is to maintain the infrastructure until decommissioning activities have been completed. ORNL is one of the locations where RPS nuclear production infrastructure is planned as described in the *NI PEIS* ROD. The Radiochemical Engineering Development Center (REDC) and High Flux Isotope Reactor (HFIR), which could be used for RPS nuclear production, are both located within ORNL (see **Figure 3–19**). ORNL's primary mission is to perform leading-edge nonweapons research and development in energy, health, and the environment. Other missions include production of radioactive and stable isotopes not available from other production sources, fundamental and applied research and development in sciences and materials development, research involving hazardous and radioactive materials, environmental research, and radioactive waste disposal.

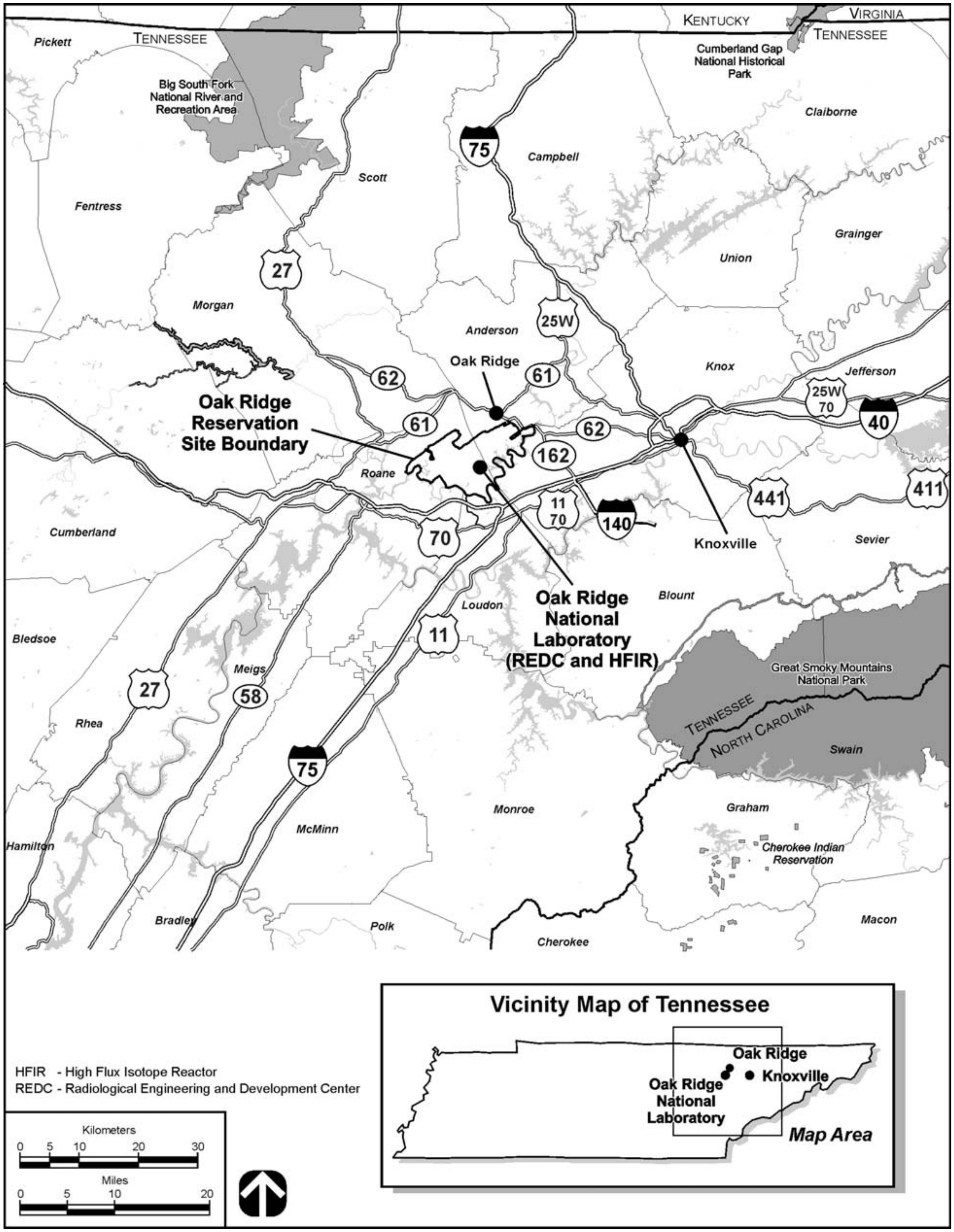

Figure 3–19 Oak Ridge Reservation Vicinity

3.4.1 Land Resources

3.4.1.1 Land Use

Lands bordering ORNL and ORR are predominantly rural and are used primarily for residences, small farms, forest land, and pasture land. The city of Oak Ridge, Tennessee, has a typical urban mix of residential, public, commercial, and industrial land uses. It also includes almost all of ORR. There are four residential areas along the northern boundary of ORR, several of which have houses located within 30 meters (98 feet) of the site boundary.

Land uses at ORR are shown in **Figure 3–20**. Land uses at the site include industrial, mixed industrial, institutional/research, institutional/environmental laboratory, and mixed research/future initiatives. Industrial and mixed industrial areas of the site include ORNL, Y-12, and the ETTP. The institutional/research category applies to land occupied by central research facilities at ORNL and the Natural and Accelerated Bioremediation Field Research Center in Bear Creek Valley near Y-12. The institutional/environmental laboratory category includes the Oak Ridge Institute for Science and Education. Land within the mixed research/future initiative category includes land that is used or available for use in field research and land reserved for future DOE initiatives. Most mixed research and future initiatives areas are forested. Undeveloped forested lands on ORR are managed for multiple use and sustained yield of quality timber products. Although soils that would be identified as prime farmland occur on the site, that designation is waived because they are within the city of Oak Ridge (DOE 2000f). Only a small fraction of ORR has been disturbed by Federal activities, including the construction and operation of facilities, roadways, or other structures.

A large number of reservation-wide land uses overlay the primary land use categories and are officially designated as mixed uses. The largest mixed use is biological and ecological research in the Oak Ridge National Environmental Research Park, which is on 8,090 hectares (20,000 acres). The National Environmental Research Park, established in 1980, is used by the Nation's scientific community as an outdoor laboratory for environmental science research on the impact of human activities on the eastern deciduous forest ecosystem. Recently, the Three Bend Scenic and Wildlife Management Refuge Area, on 1,215 hectares (3,000 acres), was set aside by DOE as a conservation and wildlife management area. The area is located in the ORR buffer zone, on Freels, Gallaher, and Solway Bends on the north shore of Melton Hill Lake (DOE 2000f). Additional details on land use plans at the site are provided in the *Oak Ridge National Laboratory Land and Facilities Plan* (ORNL 2002).

ORNL is primarily located within Bethel Valley between Haw and Chestnut Ridges, and covers 1,720 hectares (4,250 acres) of land. The site is classified as an industrial area that encompasses a number of facilities dedicated to energy research. REDC and HFIR are located in ORNL along a low ridge in Melton Valley just to the southwest of Haw Ridge. The nearest public access to these facilities, Bethel Valley Road, is located about 1,500 meters (4,920 feet) to the north, and the nearest residential area is about 4,100 meters (13,450 feet) to the southwest. Land surrounding ORNL is largely forested and is classified as mixed research/future initiatives (DOE 2000f).

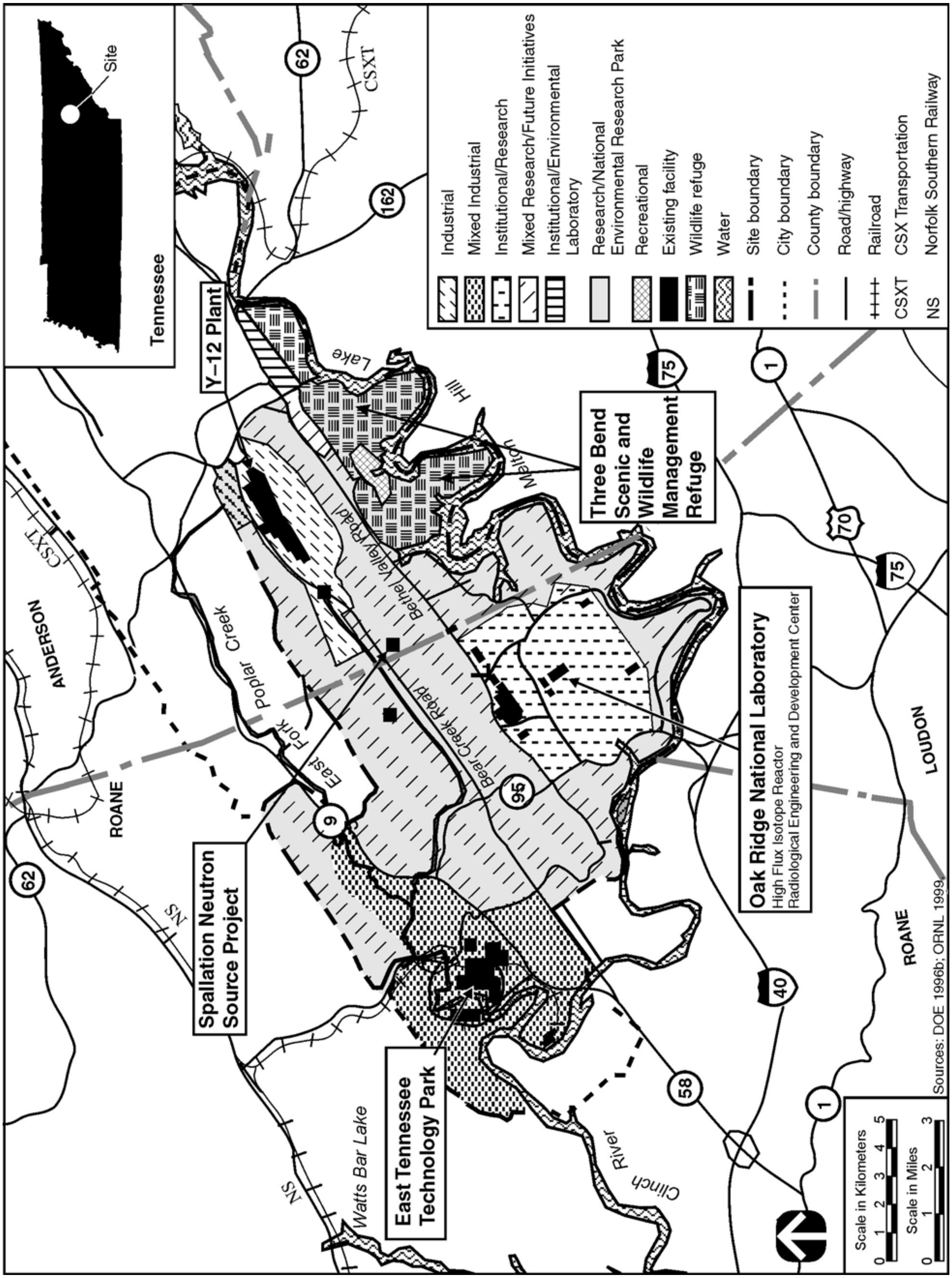

Figure 3–20 Generalized Land Use at Oak Ridge Reservation and Vicinity

3.4.1.2 Visual Resources

The landscape at ORNL and ORR is characterized by a series of ridges and valleys that trend in a northeast-to-southwest direction. The vegetation is dominated by deciduous forest mixed with some coniferous forest. Most of the original open field areas on the site have been planted in shortleaf and loblolly pine, although smaller areas have been planted in a variety of deciduous and coniferous trees. The DOE facilities are brightly lit at night, making them especially visible. The developed areas of ORNL are consistent with the Bureau of Land Management's Visual Resource Contrast Class IV rating in which management activities dominate the view and are the focus of viewer attention (DOI 1986). The remainder ranges from a Visual Resource Contrast Class II to Class III rating. Management activities within these classes may be seen, but should not dominate the view.

The viewshed consists mainly of rural land. Sensitive viewpoints affected by DOE facilities are primarily associated with Interstate 40, State Highways 58, 62, and 95, and Bethel Valley and Bear Creek Roads. The Clinch River/Melton Hill Lake, and the bluffs on the opposite side of the Clinch River also have views of ORR, but views of most of the existing DOE facilities are blocked by terrain and/or vegetation. Although only a small portion of State Highway 62 crosses ORR, it is a major route for traffic to and from Knoxville and other communities. The hilly terrain, heavy vegetation, and generally hazy atmospheric conditions limit views.

ORNL is one of several highly developed areas of ORR. As noted above, such areas are consistent with the Bureau of Land Management Visual Resource Contrast Class IV rating. While a large part of ORNL is visible from Bethel Valley Road, it is not visible to persons in offsite locations because of the presence of the Haw and Chestnut Ridges. REDC and HFIR, located to the south of the main ORNL complex, are not visible from any public area.

3.4.2 Site Infrastructure

Characteristics of ORNL's utility and ground transportation infrastructure are summarized in **Table 3–38**. Section 3.4.8.4 further discusses local transportation infrastructure, and Section 3.4.11 describes the site's waste management infrastructure.

3.4.2.1 Site Ground Transportation

Within the ORR Site, ORNL contains 290 kilometers (180 miles) of improved roadways, including 40 kilometers (25 miles) of paved roads. Within ORR, several routes are used to transfer traffic from the State Routes to the main plant areas including ORNL (ORNL 2002). Bear Creek Road, north of Y-12, flows in an east-west direction and connects Scarboro Road on the east end of the plant with State Road 95 and State Road 58. Bear Creek Road has restricted access around Y-12, and is not a public thoroughfare. Bethel Valley Road, a public roadway, provides access to ORNL, and extends from the east end of ORR at State Road 62 to the west end at State Route 95. Access to REDC and HFIR is provided by secondary roads with controlled access including First Street, which runs north-south from Bethel Valley Road, and Melton Valley Road, which runs east-west and passes the entry road (DOE 2000f).

Two main branches provide rail service for ORR. The CSX Transportation line at Elza (just east of Oak Ridge) serves Y-12 and the Office of Science and Technological Information in east Oak Ridge. The Norfolk and Southern main line from Blair provides easy access to the ETTP (DOE 2000b). No rail spur runs to the ORNL site.

Table 3–38 Oak Ridge National Laboratory Sitewide Infrastructure Characteristics

Resource	*Site Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	180 [a]	Not applicable
Railroads (kilometers)	0	Not applicable
Electricity		
Energy (megawatt-hours per year)	175,200	350,400
Peak load (megawatts)	24	40
Fuel		
Natural gas (cubic meters per year)	25,900,000	15,500,000 [b]
Fuel oil (heating) (liters per year)	866,500	Not limited [c]
Water (liters per year) [d]	6,910,000,000	9,670,000,000

[a] Includes paved and unpaved roads.
[b] Contractual limit, actual capacity is greater.
[c] Capacity is only limited by the ability to ship resource to the site.
[d] Reflects peak usage and capacity of the ORNL water supply system.
Note: To convert kilometers to miles, multiply by 0.621; liters to gallons, multiply by 0.264; and cubic meters to cubic feet, multiply by 35.315.
Sources: ORNL 2002 and 2005.

3.4.2.2 Electricity

Electrical power is supplied to ORNL and ORR by the Tennessee Valley Authority. The Power Operations Group located in the Y-12 Facilities Maintenance Organization has responsibility for coordinating operations and activities on the distribution grid and for operating and maintaining the main substations serving each individual site. Two transmission lines supply ORNL and vicinity: (1) a 13-kilometer- (8-mile-) long line that extends from the K-27 substation at the ETTP, and (2) a 10-kilometer- (6-mile-) long line that feeds from the Elza Substation located at the Y-12 Site. Each line is rated at 161 kilovolts, with each having a load capacity of approximately 110 megawatts. Transformers at the main substation reduce the voltage from these lines to 13.8 kilovolts for distribution within ORNL. Eight 13.8-kilovolt feeders further distribute power within ORNL, including a 13.8-kilovolt feeder that extends to the HFIR Substation. Five secondary 2.4-kilovolt substations, a 2.4-kilovolt distribution system consisting of 51 kilometers (32 miles) of aboveground and 6.4 kilometers (4 miles) of underground distribution lines, and over 200 facility transformers complete the primary electrical distribution system that provides power to ORNL facilities. The oldest sections of the electrical power system were built in the early-to-mid-l940s, and a number of projects have been undertaken to upgrade key components. Gasoline- or diesel-powered generators are also in place to provide power to key operations and facilities in the event of a power outage (ORNL 2002).

Total electrical energy availability to ORR from the Tennessee Valley Authority grid is 13,880,000 megawatt-hours per year. Total electrical energy consumption across ORR is about 726,000 megawatt-hours annually (DOE 2000f). This consumption reflects an average load demand of about 83 megawatts. As described above, the ORNL electric power distribution system has a maximum capacity of 80 megawatts, but is practically limited to approximately 40 megawatts (reflecting an electrical energy availability of 350,400 megawatt-hours per year). The electrical load demand at ORNL averages less than 20 megawatts for much of the year (ORNL 2002). This load demand reflects annual energy consumption of not more than about 175,200 megawatt-hours. The peak load demand for ORNL is estimated at 24 megawatts (see Table 3–38).

3.4.2.3 Fuel

The Duke Energy Company supplies natural gas to ORNL. Natural gas is used in the ORNL Central Steam Plant to heat ORNL facilities, and fuel oil is used as a backup and switching fuel. This company owns, operates, and maintains the main line and the three pressure-reducing stations that make up the supply system to the ORNL. The Power Operations Department at the Y-12 National Security Complex also has managerial responsibility for this utility. The ORNL natural gas tap is located at Metering Station B, north of Bethel Valley Road at the Melton Valley Access Road intersection. ORNL can demand up to about 15.5 million cubic meters (547.5 million cubic feet) of natural gas annually under current contract limits without incurring a penalty charge (ORNL 2002).

In 2004, ORNL consumed approximately 25.9 million cubic meters (914 million cubic feet) of natural gas. Total ORNL fuel oil consumption was about 866,500 liters (228,900 gallons) in 2004 (ORNL 2005) (see Table 3–38). No current supply limitations impact ORNL operations, as the system is designed with more capacity than is now demanded (ORNL 2002).

3.4.2.4 Water

Water for ORNL is obtained from the Clinch River south of the eastern end of the Y-12 National Security Complex and pumped to the water treatment plant located on the ridge northeast of Y-12. The treatment plant (formerly the DOE treatment facility) is owned and operated by the city of Oak Ridge. The water treatment plant can deliver water to two water storage reservoirs at a potential rate of 91 million liters (24 million gallons) per day. Water from the two reservoirs is distributed to the Y-12 Plant, ORNL, and the city of Oak Ridge. A 61-centimeter (24-inch) water line extends from the water treatment plant approximately 12 kilometers (7.5 miles) across Chestnut Ridge into ORNL. This supply line feeds the ORNL reservoir system. This system consists of one concrete reservoir with a capacity of 11.4 million liters (3 million gallons) and a new (completed in 2001) 5.7-million liter (1.5-million gallon) capacity steel reservoir on the south slope of Chestnut Ridge. Also comprising this system are two 5.7-million liter (1.5-million gallon) capacity steel reservoir tanks located on Haw Ridge that supply water to ORNL. The Haw Ridge tanks specifically provide reserve capacity for REDC, HFIR, and other facilities in Melton Valley. From these storage facilities, water flows by gravity into the distribution system for potable, sanitary, fire protection, and process uses (ORNL 2002).

Total ORNL water use ranges from about approximately 9.5 million liters (2.5 million gallons) per day (3.45 billion liters [912.5 million gallons] annually) during the winter to around 15 million liters (4 million gallons) per day (5.53 billion liters [1.46 billion gallons] annually) during the summer, but can approach 19 million liters (5 million gallons) per day (6.91 billion liters [1.83 billion gallons] annually). A flow of 26.5 million liters (7 million gallons) per day (9.67 billion liters [2.55 billion gallons] annually) can be accommodated by the ORNL supply system under current operating conditions (see Table 3–38). Loss of the single supply line from the water plant, or any activity that would cause loss of the reserve capacity of one of the reservoirs, could impact ORNL operations within a short period of time (ORNL 2002).

Either of the two reservoirs is capable of supplying the normal 3,785 liters (1,000 gallons) per minute cooling water requirements of HFIR. The HFIR complex uses a total of approximately 6.1 million liters (1.6 million gallons) of water per day or about 2.23 billion liters (589 million gallons) annually. REDC uses approximately 294,000 liters (77,800 gallons) of water per day or 107 million liters (28.4 million gallons) per year (DOE 2000f).

3.4.3 Geology and Soils

3.4.3.1 Geology

ORNL is in the southwestern portion of the Valley and Ridge physiographic province in east-central Tennessee. The topography consists of alternating valleys and ridges that have a southwest-northeast trend, with most facilities occupying the valleys. The topography reflects the underlying geology, which consists of a sequence of sedimentary rocks deformed by a series of major southeast-dipping thrust faults (**Figures 3–21 and 3–22**). The ridges are underlain by relatively erosion-resistant rocks, while weaker rock strata underlie the valleys. The ORNL main site is located in Bethel Valley between Haw and Chestnut Ridges. REDC and HFIR are located on a low ridge in Melton Valley, south of Haw Ridge (DOE 2000f).

<table>
<tr><th colspan="2">Age</th><th>Group</th><th colspan="2">Formation</th><th>Thickness (meters)</th><th>Hydrologic Unit</th></tr>
<tr><td rowspan="13">Ordovician</td><td rowspan="3">Upper</td><td rowspan="9">Chickamauga Group</td><td colspan="2">Moccasin Formation</td><td>100–170</td><td rowspan="3">Aquitard</td></tr>
<tr><td colspan="2">Witten Formation</td><td>105–110</td></tr>
<tr><td colspan="2">Bowen Formation</td><td>5–10</td></tr>
<tr><td rowspan="6">Middle</td><td colspan="2">Benbolt/Wardell Formation</td><td>110–115</td><td rowspan="2">Aquifer</td></tr>
<tr><td colspan="2">Rockdell Formation</td><td>80–85</td></tr>
<tr><td>Hogskin Member
Fleanor Shale Member</td><td rowspan="2">Lincolnshire Formation</td><td>75–80</td><td rowspan="3">Aquitard</td></tr>
<tr><td>Eidson Member</td><td rowspan="2">70–80</td></tr>
<tr><td colspan="2">Blackford Formation</td></tr>
<tr><td rowspan="4">Lower</td><td rowspan="5">Knox Group</td><td colspan="2">Mascot Dolomite</td><td>75–150</td><td rowspan="6">Knox Aquifer</td></tr>
<tr><td colspan="2">Kingsport Formation</td><td>90–150</td></tr>
<tr><td colspan="2">Longview Dolomite</td><td>40–60</td></tr>
<tr><td colspan="2">Chepultepec Dolomite</td><td>152–213</td></tr>
<tr><td rowspan="8">Cambrian</td><td rowspan="2">Upper</td><td colspan="2">Copper Ridge Dolomite</td><td>244–335</td></tr>
<tr><td rowspan="6">Conasauga Group</td><td colspan="2">Maynardville Limestone</td><td>100–110</td></tr>
<tr><td rowspan="5">Middle</td><td colspan="2">Nolichucky Shale</td><td>150–180</td><td rowspan="6">Aquitard</td></tr>
<tr><td colspan="2">Dismal Gap Formation (Formerly Maryville Limestone)</td><td>98–125</td></tr>
<tr><td colspan="2">Rogersville Shale</td><td>25–34</td></tr>
<tr><td colspan="2">Friendship Formation (Formerly Rutledge Limestone)</td><td>31–37</td></tr>
<tr><td colspan="2">Pumpkin Valley Shale</td><td>56–70</td></tr>
<tr><td>Lower</td><td></td><td colspan="2">Rome Formation</td><td>122–183</td></tr>
</table>

Source: DOE 2000f. Note: To convert meters to feet multiply by 3.281.

Figure 3–21 Stratigraphic Column for the Oak Ridge National Laboratory

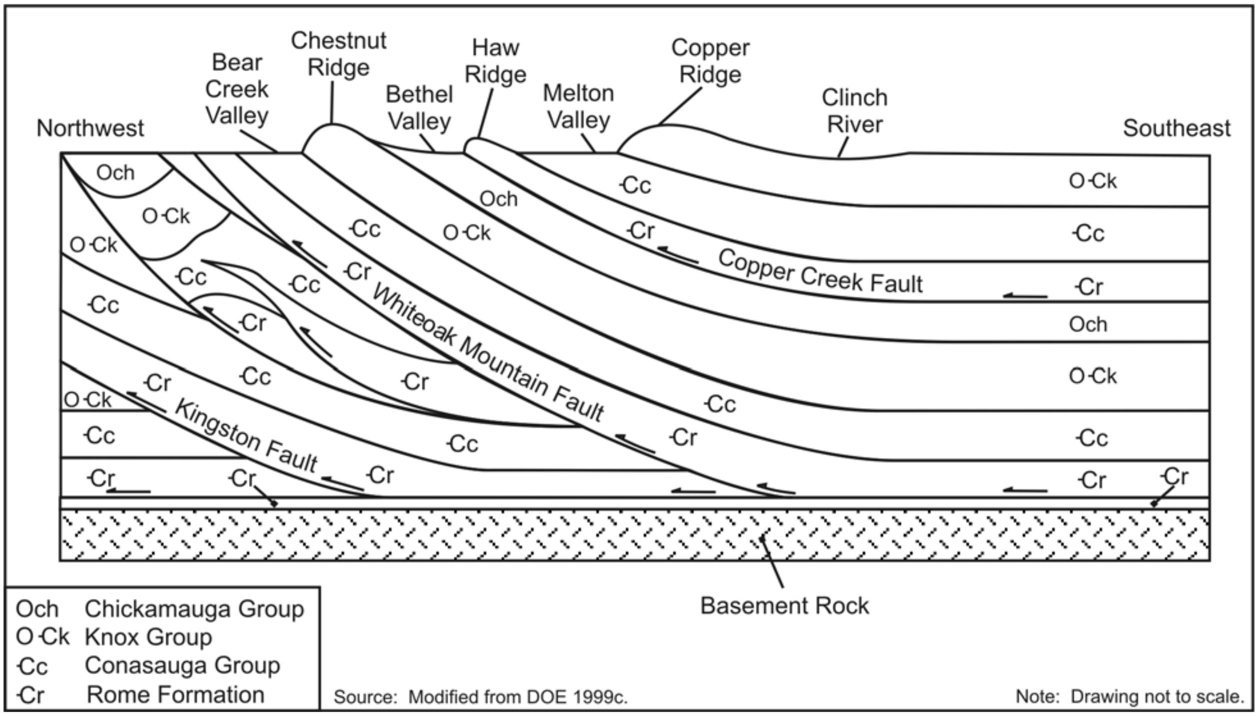

Figure 3–22 Geologic Cross Section of the Oak Ridge National Laboratory

Bedrock in the ORNL vicinity is of Early Cambrian (about 570 million years ago) to Ordovician Age (505 to 540 million years ago). The bedrock units encompass a wide variety of lithologies ranging from pure limestone to dolostone to fine sandstone. The total thickness of the stratigraphic section is about 2.6 kilometers (1.6 miles). Four primary geologic units occur in the area. These include (from oldest to youngest) the Rome Formation, Conasauga Group, Knox Group, and Chickamauga Group. The Conasauga Group, Knox Group, and Chickamauga Group are comprised of individual geologic formations that have been combined based on general lithology types and age. Because of their unique lithologies, the major stratigraphic units possesses different mechanical characteristics and have responded differently to the strains imparted on them through time. In general, the Maynardville Limestone of the Conasauga Group, the Knox Group, and most of the overlying Chickamauga Group act as brittle, but competent, units within the major thrust sheets in the vicinity of ORNL. The Rome Formation, all of the Conasauga Group below the Maynardville Limestone, and the Moccasin Formation of the Chickamauga Group (weak units) readily deform under stress; these units often contain fault planes along which movement has occurred. These faults have been largely inactive in recent geologic time. The Rome Formation and Knox Group are chemically resistant to weathering; thus, these units form the principal ridges. The Chickamauga Group and Conasauga Group formations underlie the valleys (DOE 2000b).

There is no evidence of active capable faults in the Valley and Ridge physiographic province or within the rocks comprising the Appalachian Basin structural feature where ORNL is located. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years, or recurrent movement within the past 500,000 years (10 CFR Part 100, Appendix A). The nearest capable faults are approximately 480 kilometers (298 miles) northwest in the New Madrid (Reelfoot Rift) Fault Zone. Historical earthquakes occurring in the Valley and Ridge are not attributable to fault structures in underlying sedimentary rocks, but rather occur at depth in basement rock (DOE 2000f).

The historical seismicity of the southeastern United States relative to ORNL has been extensively reviewed in recent years. Since the New Madrid earthquakes of 1811 to 1812, at least 27 other earthquakes with an MMI of III to VI (see Appendix B of this EIS) have been felt in the Oak Ridge area. One of closest and most intense seismic events occurred in 1930, approximately 8 kilometers (5 miles) from ORR, and had an MMI of V at the site. The largest recent earthquake in eastern Tennessee registered 4.6 on the Richter scale and occurred on November 30, 1973, in Maryville, Tennessee, about 32 kilometers (20 miles) southeast of ORR. This earthquake produced an MMI of V to VI at ORNL (as estimated at HFIR) (DOE 2000f). The region has continued to be seismically active, with 49 earthquakes recorded within a radius of 100 kilometers (62 miles) of ORNL since 1973. The closest of those events occurred on June 17, 1998, with an epicenter within ORR near the ETTP, registering a magnitude 3.6 (USGS 2005d).

Earthquake-produced ground motion is expressed in units of "g" (force of acceleration relative to that of the earth's gravity). Two differing measures of this motion are peak (ground) acceleration and response spectral acceleration. For ORNL facilities, the calculated maximum considered earthquake ground motion ranges from approximately 0.47g for an 0.2-second spectral response acceleration to 0.11g for a 1.0-second spectral response acceleration. The calculated peak ground acceleration for the given probability of exceedance at the site is approximately 0.28g (USGS 2005b). These are representative of MMI VII earthquake damage (BSSC 2004). Table B–7 in Appendix B of this EIS shows the approximate correlation between MMI, earthquake magnitude, and peak ground acceleration.

As stated in DOE Order 420.1A, DOE requires that nuclear or nonnuclear facilities be designed, constructed, and operated so that the public, the workers, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Based on historical observations, the maximum earthquake having an epicenter at ORNL would be an MMI VIII event. Numerous studies have been conducted as part of establishing the design-basis earthquake for evaluating and designing new ORR facilities. For this purpose, an earthquake producing an effective peak-ground acceleration of 0.15g has been established and calculated to have an annual probability of occurrence of about 1 in 1,000. For comparison, an earthquake with a peak acceleration of 0.32g has an annual probability of occurrence of 1 in 5,000 (DOE 2000f).

There is no volcanic hazard at ORNL. The area has not experienced volcanic activity within the last 230 million years (DOE 2000f).

3.4.3.2 Soils

The four soil map units identified at ORNL are the Fullerton-Claiborne-Bodine; Collegedale-Gladeville-Rock outcrop; Lehew-Armuchee-Muskingum; and Armuchee-Montevallo-Hamblen units. Soils of the Fullerton-Claiborne-Bodine unit may be described as deep, rolling-to-steep, well-drained cherty and noncherty soils underlain by dolomite. They occur on rolling ridgetops and on all aspects of steep side slopes. The Collegedale-Gladeville-Rock outcrop soil unit consists of deep and shallow, rolling and hilly well-drained soils that are underlain by limestone and have many outcrops of limestone. Soils of this group occur on uplands. Soils of the Lehew-Armuchee-Muskingum unit are moderately deep, steep, well-drained soils underlain by multicolored shale, siltstone, and sandstone. This unit is found on high winding ridges. The Armuchee-Montevallo-Hamblen soil unit is made up of shallow-to-deep, steep to nearly level, well-drained and moderately well-drained soils underlain by shale. This unit occurs on uplands and bottomlands. While there are soils that would be classified as prime farmland on ORR, that designation is waived within the ORR site boundary (DOE 2000f).

The ORNL main site is underlain primarily by calcareous siltstones and silty-to-clean limestone of the Chickamauga Group. Melton Valley is underlain by the interbedded limestones and shales of the Conasauga Group. Most of REDC at HFIR is underlain by the Maryville Limestone with the southern limits of the site bordering the Nolichucky Shale (Figures 3–21 and 3–22). In particular, the bedrock beneath the HFIR complex is described as a dark-gray, calcareous clay shale overlain by up to 6 meters (20 feet) of saprolite (weathered bedrock) with only a thin topsoil. Karst features are less developed in the Chickamauga Group than in the Knox Group. Cavities encountered are smaller and often clay-filled, and caves are sparse and typically small, with the same observation expected for the Conasauga Group. Soils of ORNL are highly disturbed and would be classified as Urban Land. Urban Land includes areas where more than 80 percent of the surface is covered with industrial plants, paved parking lots, and other impervious surfaces (DOE 2000f).

3.4.4 Water Resources

3.4.4.1 Surface Water

The major surface water feature in the immediate vicinity of ORNL is the Clinch River, which borders ORR to the south and west. There are four major subdrainage basins on ORR that flow into the Clinch River and are affected by site operations: Poplar Creek, East Fork Poplar Creek, Bear Creek, and White Oak Creek. Several smaller drainage basins, including Ish Creek, Grassy Creek, Bearden Creek, McCoy Branch, Kerr Hollow Branch, and Raccoon Creek, drain directly to the Clinch River (**Figure 3–23**). Each drainage basin takes the name of the major stream flowing through the area. The three major facilities at ORR each affect different basins of the Clinch River. Drainage from Y-12 enters both Bear Creek and East Fork Poplar Creek; the ETTP drains mainly into Poplar Creek; and ORNL drains into White Oak Creek (DOE 2000f).

The Clinch River and connected waterways supply raw water for ORNL. The Clinch River has an average flow rate of 132 cubic meters (4,647 cubic feet) per second, as measured at the downstream side of Melton Hill Dam. ORR uses 14,210 million liters (3,754 million gallons) per year. The ORR water supply system, which includes the city of Oak Ridge treatment facility (formerly the DOE treatment facility) and the ETTP treatment facility, has a capacity of 90.8 to 121.5 million liters (24 to 32.1 million gallons) per day (DOE 2000f). Water use is detailed in Section 3.4.2.4.

The Clinch River water levels in the vicinity of ORR are regulated by a system of dams operated by the Tennessee Valley Authority. Melton Hill Dam controls the flow of the Clinch River along the northeast and southeast sides of ORR. Watts Bar Dam on the Tennessee River near the lower end of the Clinch River controls the flow of the Clinch River along the southwest side of ORR (DOE 2000f).

The surface streams of Tennessee are classified by the Tennessee Department of Environmental Conservation according to the Use Classifications for Surface Waters. Classifications are based on water quality, beneficial uses, and resident aquatic biota. The Clinch River is the only surface water body near ORNL classified for domestic water supply. Unless otherwise specified in these rules, all streams in Tennessee are classified for use for fish and aquatic life, recreation, irrigation, and for livestock watering and wildlife. In addition, the Clinch River and a short segment of Poplar Creek from its confluence with the Clinch River are also classified for industrial water supply use. White Oak Creek and Melton Branch are the only streams not classified for irrigation. East Fork Poplar Creek is posted by the state of Tennessee with warnings against fishing and contact recreation (DOE 2000f).

Wastewater treatment facilities are located throughout ORR, including six treatment facilities at Y-12 that discharge to East Fork Poplar Creek, and three treatment facilities at ORNL that discharge into White Oak Creek Basin. These discharge points are included in existing NPDES permits (DOE 2000b, Hughes et al. 2004).

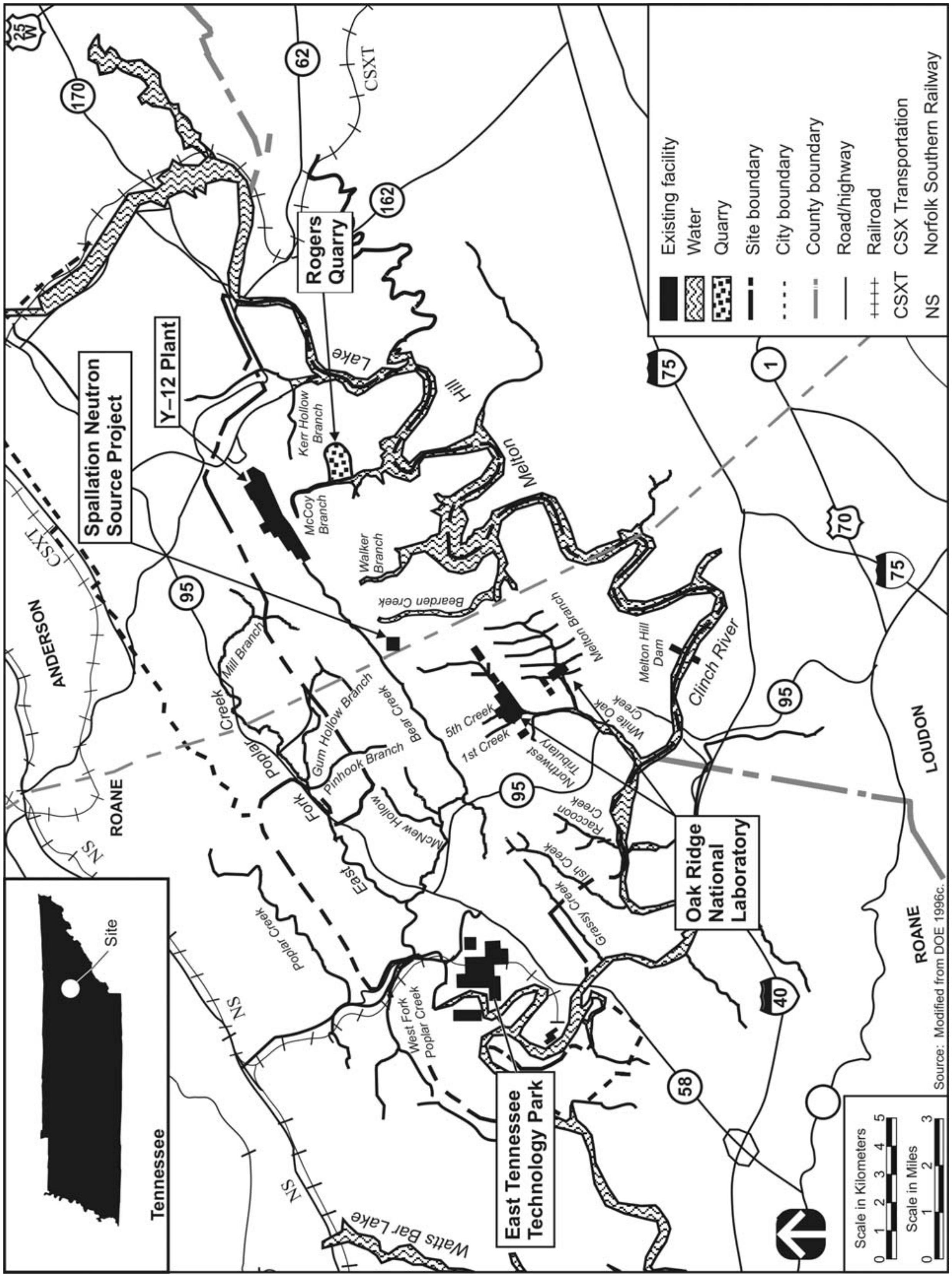

Figure 3–23 Surface Water Features in the Vicinity of Oak Ridge National Laboratory

There are approximately 400 NPDES-permitted outfalls at ORR associated with the 3 major facilities (Y-12 Plant, ETTP, and ORNL); many of these are storm water outfalls. The current permit lists 164 point-source discharges that require compliance monitoring. Approximately 100 of these are storm drains, roof drains, and parking lot drains. The NPDES permit limit compliance rate for all discharge points for the three major facilities in 2003 was over 99 percent (Hughes et al. 2004).

At ORNL, water samples are collected and analyzed from 18 locations around the reservation to assess the impact of past and current DOE operations on the quality of local surface water. Sampling locations include streams, both upstream and downstream of ORNL waste sources, and public water intakes. Samples are collected and analyzed for general water quality parameters at all locations, and are screened for radioactivity and analyzed for specific radionuclides, when appropriate. White Oak Lake at White Oak Dam is also checked for volatile organic compounds, polychlorinated biphenyls, and metals. Radionuclides were detected above minimum detectable activity at all surface water locations in 2003. The levels of gross beta, total radioactive strontium, and tritium continue to be highest at Melton Branch (0.2 kilometers [0.1 miles] downstream from ORNL), White Oak Creek at White Oak Dam, and White Oak Creek (2.6 kilometers [1.6 miles] downstream from ORNL). These data are consistent with historical data and with the processes or legacy activities nearby or upstream from these locations. Volatile organic compounds were also detected at White Oak Creek at White Oak Dam in 2003, including chloroform and acetone, which are common laboratory contaminants. Two other locations, one on Northwest Tributary and one on Raccoon Creek also had elevated levels of gross beta and total radioactive strontium. Both of these locations are impacted by contaminated groundwater from Solid Waste Storage Area #3 (Hughes et al. 2004).

The Tennessee Valley Authority has conducted flood studies along the Clinch River, Bear Creek, and East Fork Poplar Creek, and has also performed probable maximum flood studies along the Clinch River. The probable maximum flood is that which could be expected from the most severe combination of critical hydrometeorological conditions that are reasonably possible over the entire watershed. The probable maximum flood level along the Clinch River at the mouth of Bearden Creek would occur at elevation 248.3 meters (814.7 feet), while the probable maximum flood level at the mouth of White Oak Creek would occur at elevation 237.5 meters (779.3 feet). Based on the studies, most of ORNL is above the probable maximum flood elevation along the Clinch River (DOE 2000f).

Sanitary wastewater from the REDC and HFIR is conveyed to the ORNL Sewage Treatment Plant, which provides primary, secondary, and tertiary sewage treatment. The Sewage Treatment Plant has a treatment capacity of 1.1 million liters (300,000 gallons) per day. Since 1997, treated flows have ranged from about 685,000 to 821,000 liters (181,000 to 217,000 gallons) per day. Specifically, the HFIR complex is estimated to generate about 7.3 million liters (1.93 million gallons) of sanitary wastewater per year, with REDC generating an additional 3.1 million liters (828,000 gallons) annually (DOE 2000f).

Process wastewater from REDC and HFIR is collected and conveyed to storage tanks prior to processing in the Process Waste Treatment Complex. All treated wastewater is ultimately discharged to White Oak Creek through a single NPDES-permitted outfall (Outfall X12). The flow rate from this outfall averages about 2.08 million liters (550,000 gallons) per day, of which approximately 66,245 liters (17,500 gallons) per day are attributable to process wastewater from REDC and HFIR. The treated effluent from Outfall X12 meets NPDES water quality-based limits for metals and organics and DOE Derived Concentration Guides (DOE Order 5400.5), and is not toxic to aquatic species based on NPDES-required toxicity testing. REDC and HFIR also discharge dechlorinated cooling water and cooling tower blowdown to Melton Branch through NPDES-permitted Outfalls 081 and 281. Discharge from Outfall 281, which is predominantly HFIR cooling tower blowdown, averages about 378,500 liters (100,000 gallons) per day in the warm months. The discharge rate from Outfall 081 averages approximately 265,000 liters (70,000 gallons) per day during the warm months and consists primarily of REDC cooling water

(DOE 2000f). Waste management activities and facilities are discussed in greater detail under Section 3.4.11.

Melton Branch, the primary stream in the immediate vicinity of REDC and HFIR, was analyzed to assess the potential for flooding from a locally intense storm, based on probable maximum precipitation events. The analysis determined that the relatively high elevation of the terrain and slope ensures that locally intense precipitation would not cause the Melton Branch to flood equipment at HFIR. Likewise, the occurrence of a probable maximum flood at the mouth of White Oak Creek or along Melton Branch due to probable maximum precipitation events would not inundate HFIR. Surface runoff and facility drainage flows to either of two headwater tributaries of Melton Branch on the east and west sides, respectively, of REDC and HFIR (DOE 2000f).

3.4.4.2 Groundwater

Groundwater in the vicinity of ORNL occurs both in the unsaturated zone as transient, shallow subsurface stormflow and within the deeper saturated zone. An unsaturated zone of variable thickness separates the stormflow zone and water table. Adjacent to surface water features or in valley floors, the water table is found at shallow depths, and the unsaturated zone is thin. Along the ridge tops or near other high topographic areas, the unsaturated zone is thick, and the water table often lies at considerable depth [15 to 50 meters (50 to 175 feet) deep]. In low-lying areas where the water table occurs near the surface, the stormflow zone and saturated zone are indistinguishable. It is estimated that in undisturbed, naturally vegetated areas at ORR, about 90 percent of the infiltrating precipitation does not reach the water table but travels through the 1- to 2-meter (3- to 7-feet) stormflow zone, which approximately corresponds to the root zone. This condition exists because of the permeability contrast between the shallow stormflow zone and the underlying unsaturated zone (Hughes et al. 2004).

Two broad hydrologic groupings have been characterized at ORR, each having fundamentally different characteristics. The Knox Group and the Maynardville Limestone of the Conasauga Group constitute the Knox Aquifer, in which flow is dominated by a combination of solution conduits and weathered permeable fractures. The less permeable ORR aquitard units constitute the second regime, in which flow is dominated by fractures alone. These hydrologic groupings and the geologic units comprising them are illustrated in Figure 3–21. The combination of fractures and solution conduits in the dolostones and limestones of the Knox Aquifer control flow over substantial areas, and rather large quantities of water may move relatively long distances. Active groundwater flow can occur at substantial depths in the Knox Aquifer (91.5 to 122 meters [300 to 400 feet] deep). The Knox Aquifer is the primary source of groundwater to many streams (base-flow), and most large springs on ORR receive discharge from the Knox Aquifer. Yields of some wells penetrating larger solution conduits are reported to exceed 3,785 liters (1,000 gallons) per minute (Hughes et al. 2004).

Units constituting the ORR aquitards include the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group, and consist mainly of siltstone, shale, sandstone, and thinly bedded limestone of low to very low permeability. The typical yield of a well in the aquitards is less than 3.8 liters (1 gallon) per minute, and the base flows of streams draining areas underlain by the aquitards are poorly sustained because of such low flow rates (DOE 2000f). Most water in the saturated zone in the ORR aquitards is transmitted through a 1- to 6-meter (3- to 20-feet) layer of closely spaced, well-connected fractures near the water table. Modeling by the U.S. Geological Survey indicates that 95 percent of all groundwater flow occurs in the upper 15 to 30 meters (50 to 100 feet) of the saturated zone in the ORR aquitards. As a result, flow paths in the active flow zones of the aquitards are relatively short, and nearly all groundwater discharges to local surface water drainages on the ORR (Hughes et al. 2004, DOE 2000f).

Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at ORNL. Only one water supply well exists; it provides a supplemental water supply to an ORNL aquatic biology laboratory during extended droughts (DOE 2000f). Industrial and drinking water supplies are primarily taken from surface water sources. However, single-family wells are common in adjacent rural areas not served by the public water supply system. Most of the residential wells in the immediate vicinity of ORNL are south of the Clinch River. Groundwater rights in the state of Tennessee are traditionally associated with the Reasonable Use Doctrine. Under this doctrine, landowners can withdraw groundwater as long as they exercise their rights reasonably in relation to the rights of others (DOE 2000f).

Background groundwater quality at ORR is generally good and of the calcium-magnesium-bicarbonate type in the near-surface saturated zone and the Knox Aquifer. It is poor in the deep saturated zone (particularly in the aquitards) at depths greater than 305 meters (1,000 feet), due to high total dissolved solids where the groundwater is of the sodium-chloride type (Hughes et al. 2004).

Groundwater near ORNL has been locally contaminated by hazardous chemicals and radionuclides from past process activities. The contaminated sites include past waste disposal sites, waste storage tanks, spill sites, and contaminated inactive facilities (DOE 2000f). The groundwater monitoring program at ORNL consists of a network of wells of two basic types and functions: (1) water quality monitoring wells built to RCRA specifications and used for site characterization and compliance purposes, and (2) piezometer wells used to characterize groundwater flow conditions. The groundwater surveillance monitoring program is managed by the University of Tennessee-Battelle for the DOE Office of Science. Monitoring wells have been established around the perimeter of the WAGs determined to have a potential for release of contaminants. The University of Tennessee-Battelle's WAG perimeter monitoring network and the ORNL plant perimeter groundwater surveillance program involved 49 wells in 2003. The ORNL exit pathway program is designated to monitor groundwater at locations that are thought to be likely exit pathways for groundwater affected by activities at ORNL. Four of the 10 wells that make up ORNL's exit pathway monitoring program are also part of the WAG perimeter monitoring program. In the current ORNL program, groundwater quality wells are sampled on an annual basis (Hughes et al. 2004).

Three radiological contaminant constituents exceeded their respective reference values in 2003: tritium, gross alpha activity, and gross beta activity. In particular, one monitoring well located downgradient of the HFIR complex indicates that a statistically significant upward trend continues to be observed for tritium. This is attributed to the tritium leak from the process waste drain line that occurred in 2000, and was repaired during the summer of 2001. Overall, most monitoring locations immediately downgradient of HFIR and the point of release continue to show a decrease in tritium with the results indicating that the tritium plume is moving downgradient away from HFIR toward eventual discharge into Melton Branch (Hughes et al. 2004). More complete information on groundwater monitoring and chemical analysis is presented in the annual site environmental report.

Groundwater is not used for drinking water at ORNL. In general, contaminant plumes in groundwater at ORNL are relatively small in areal extent, as contaminant sources are discretely located and flow paths to surface water outlets are short (Hughes et al. 2004).

3.4.5 Air Quality and Noise

3.4.5.1 Air Quality

The climate at ORNL may be classified as humid continental, but is moderated by the influence of the Cumberland and Great Smoky Mountains. Winters are mild and summers are warm, with no noticeable extremes in precipitation, temperature, or winds. The average annual temperature is 13.7 °C (56.6 °F);

average monthly temperatures range from a minimum of 2.2 °C (36 °F) in January to a maximum of 24.9 °C (76.8 °F) in July. The average annual precipitation is 138.5 centimeters (54.5 inches). Prevailing winds at ORNL generally follow the valley up the valley – from the southwest during the daytime, or down the valley from the northeast during the nighttime. The wind speed is less than 11.9 kilometers per hour (7.4 miles per hour) 75 percent of the time; tornadoes and winds exceeding 30 kilometers per hour (18 miles per hour) are rare (DOE 2000f).

Airborne discharges from ORNL facilities, both radioactive and nonradioactive, are subject to regulation by EPA and the Tennessee Department of Environment and Conservation (TDEC) Division of Air Pollution Control. Radioactive emissions are regulated by EPA under the National Emissions Standards for Hazardous Air Pollutants regulations in 40 CFR 61, Subpart H, and by the rules of the TDEC Division of Air Pollution Control, 1200-3-11.08.

ORNL is located in the Eastern Tennessee and Southwestern Virginia Interstate Air Quality Control Region #207. Air quality surrounding the Oak Ridge area is relatively good. However, Anderson County has been designated as a nonattainment area for the 8-hour ozone standard, as part of the larger Knoxville nonattainment area. Also, Anderson County and a portion of Roane County have been designated as nonattainment for the new, stricter Federal fine particulate matter ($PM_{2.5}$) air quality standard. For all other criteria pollutants for which EPA has made attainment designations, existing air quality in the greater Knoxville and Oak Ridge areas is in attainment with NAAQS (40 CFR 81.343). Applicable NAAQS and Tennessee State ambient air quality standards are presented in **Table 3–39**.

Nonradiological Releases

One Prevention of Significant Deterioration Class I area can be found in the vicinity of ORNL. A Class I area is one in which very little increase in pollution is allowed due to the pristine nature of the area. This area, the Great Smoky Mountains, is located 48.3 kilometers (30 miles) southeast of ORR. ORNL and its vicinity are classified as a Class II area, in which more moderate increases in pollution are allowed. Since the creation of the Prevention of Significant Deterioration program in 1977, no Prevention of Significant Deterioration permits have been issued for any emission source at ORR (DOE 2000f).

The TDEC Division of Air Pollution Control issues air permits for nonradiological and radiological airborne emissions for ORNL. Nine major sources of air emissions from ORNL operations are covered under a Title V Operating Permit (Permit Number 556850). In addition to this permit, ORNL also has a construction permit. The primary sources of nonradioactive emissions at ORNL include the steam plant (six boilers) on the main ORNL site and four small package-unit boilers located at the 7600 Area Complex and the Spallation Neutron Source. These sources account for approximately 75 percent of ORNL's allowable emissions. During 2003, TDEC inspected all permitted emission sources at ORNL, and all were found to be in compliance (Hughes et al. 2004).

The existing ambient air pollutant concentrations attributable to sources at ORNL are presented in **Table 3–40**. These concentrations are based on dispersion modeling, using emissions for the year 1998. Only those pollutants that would be emitted by any of the alternatives evaluated in this EIS are presented. As shown in Table 3–40, modeled concentrations associated with REDC and HFIR emission sources represent a small percentage of the ambient air quality standard.

The closest offsite monitors are operated by the TDEC in Anderson County and the city of Knoxville. In 1999, these monitors reported a maximum 8-hour average carbon monoxide concentration of 4,466 micrograms per cubic meter and maximum 1-hour average concentration of 12,712 micrograms per cubic meter. An annual average particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) concentration of 30.0 micrograms per cubic meter and a maximum 24-hour average concentration of 71 micrograms per cubic meter were reported. Annual, 24-hour, and 3-hour average sulfur dioxide maximum concentrations of 7.9 micrograms per cubic meter, 78.5 micrograms per cubic meter, and 293 micrograms per cubic meter, respectively, were also reported in 1999 (DOE 2000f).

Table 3–39 Comparison of Modeled Ambient Air Concentrations from Oak Ridge Reservation Sources with Most Stringent Applicable Standards or Guidelines, 1998

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline* [a] *(micrograms per cubic meters)*	*ORR Concentration (micrograms per cubic meters)*
Criteria pollutants			
Carbon monoxide	8 hours 1 hour	10,000 [b] 40,000 [b]	8.05 27.1
Nitrogen dioxide Ozone	Annual 8 hours 1 hour	100 [b] 157 235 [c]	1.58 (d) (d)
PM_{10}	Annual 24 hours	50 [b] 150 [b]	1.6 12.7
$PM_{2.5}$	Annual 24 hours	15 [e] 65 [e]	1.6 [f] 12.7 [f]
Sulfur dioxide	Annual 24 hours 3 hours	80 [b] 365 [b] 1,300 [b]	4.86 35.7 112.0
Other regulated pollutants			
Total suspended particulates	24 hours	150 [g]	2 [h]

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] Federal and state standard.
[c] Federal 8-hour standard.
[d] Not directly emitted or monitored by the site.
[e] Federal standard.
[f] Assumed to be the same as PM_{10} because there are no specific data for $PM_{2.5}$.
[g] State standard.
[h] Based on stack emissions of particulate matter only.
Note: Emissions of hazardous air pollutants not listed here have been identified at ORR, but are not associated with any alternative evaluated in this EIS. EPA revised the ambient air quality standards for particulate matter and ozone in 1997 (62 FR 38856, 62 FR 38652).
Source: DOE 2000f.

Current nonradiological emissions from the REDC and HFIR are minimal, and result from wet chemistry and laboratory scale activities located at the facility. Additional nonradiological emissions result from maintenance activities inside the facility and in a small shop located adjacent to REDC and HFIR, and testing of emergency diesel generators. Current TDEC air pollution control rules do not require that these emissions be permitted or quantified (DOE 2000f). The existing ambient air pollutant concentrations attributable to sources at REDC and HFIR are presented in Table 3–40. These concentrations are estimated using SCREEN3 and are expected to overestimate the contribution to site boundary concentrations.

The primary sources of nonradiological air pollutants at ORNL include the facility steam plant and two small oil-fired boilers, which account for 98 percent of all allowable emissions. In 2003, ORNL had 11 operations air permits covering numerous air emission sources. All permitted sources were in compliance (DOE 2004g).

Table 3–40 Comparison of Modeled Ambient Air Concentrations from Sources at the Radiochemical Engineering Development Center and High Flux Isotope Reactor with Most Stringent Applicable Standards or Guidelines

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline* [a] *(micrograms per cubic meters)*	*REDC/HFIR Concentration (micrograms per cubic meters)*
Criteria pollutants			
Carbon monoxide	8 hours	10,000 [b]	31.5
	1 hour	40,000 [b]	45.1
Nitrogen dioxide	Annual	100 [b]	0.0072
Ozone	1 hour	235 [c]	(d)
PM_{10}	Annual	50 [b]	0.0005
	24 hours	150 [b]	5.96
Sulfur dioxide	Annual	80 [b]	0.0005
	24 hours	365 [b]	5.51
	3 hours	1,300 [b]	12.4
Other regulated pollutants			
Total suspended particulates	24 hours	150 [e]	5.96

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] Federal and state standard.
[c] Federal 8-hour standard is currently under litigation.
[d] Not directly emitted or monitored by the site.
[e] State standard.
Source: DOE 2000f.

Radiological Releases

Radiological air emissions in 2003 from ORNL are presented in **Table 3–41**. The total curies and mass of isotopes discharged to the air can vary from year to year. The variations are attributable to changes in project activities and source process rates.

Radioactive airborne discharges at ORNL consist primarily of ventilation air from radioactively contaminated or potentially contaminated areas, vents from tanks and processes, and ventilation from reactor facilities. These airborne emissions are treated and then filtered with high-efficiency particulate air (HEPA) filters and/or charcoal filters before discharge. Radiological airborne emissions from ORNL consist of solid particulates; adsorbable gases (e.g., iodine), tritium, and nonadsorbable gases (i.e., noble gases). The major radiological emission point sources for ORNL consist of the following five stacks located in Bethel and Melton Valleys:

- High Radiation Level Analytical Laboratory;
- Radiochemical Processing Plant;
- Central off-gas and scrubber system, which includes cell ventilation system, isotope solid-state ventilation system, and central off-gas system;
- MSRE remediation; and
- Melton Valley Complex, which serves REDC and HFIR.

Table 3–41 Radiological Airborne Releases to the Environment at Oak Ridge National Laboratory in 2003 [a]

Emission Type	*Radionuclide*	*Curies*
Noble gases	Argon-41	2.31×10^{3}
	Krypton-85	8.58×10^{2}
	Krypton-85m	3.77×10^{1}
	Krypton-87	1.42×10^{2}
	Krypton-88	1.06×10^{2}
	Xenon-131m	1.64×10^{2}
	Xenon-133	1.64×10^{2}
	Xenon-133m	1.80×10^{1}
	Xenon-135	1.25×10^{2}
	Xenon-135m	7.17×10^{1}
	Xenon-138	4.04×10^{2}
Airborne particulates	Beryllium-7	1.06×10^{-5}
	Cobalt-60	9.67×10^{-6}
	Selenium-75	3.34×10^{-5}
	Strontium-90	2.79×10^{-3}
	Yttrium-90	1.57×10^{-3}
	Cesium-137	8.45×10^{-3}
	Cesium-138	2.81×10^{3}
	Barium-139	1.44×10^{0}
	Barium-140	2.93×10^{-4}
	Lanthanum-140	1.92×10^{-4}
	Osmium-191	3.10×10^{0}
	Lead-212	2.15×10^{0}
	Thorium-228	2.60×10^{-6}
	Thorium-230	1.71×10^{-6}
	Thorium-232	1.41×10^{-6}
	Uranium-234/235/238	1.32×10^{-4}
	Plutonium-238	1.27×10^{-4}
	Plutonium-239	2.39×10^{-4}
	Americium-241	2.31×10^{-4}
	Curium-242	1.13×10^{-4}
Nitrogens, oxygens, and iodine isotopes	Iodine-131	5.92×10^{-2}
	Iodine-132	6.98×10^{-1}
	Iodine-133	3.05×10^{-1}
	Iodine-134	9.26×10^{-1}
	Iodine-135	9.18×10^{-1}
Tritium and carbons	Tritium (hydrogen-3)	$1.03 \times 10^{+2}$

[a] Radionuclides with half-lives less than about 10 minutes are not included in the table (e.g., short-lived carbon, oxygen, and nitrogen isotopes). Also, not included are radionuclides for which less than 10^{-6} curies are released per year.
Source: Hughes et al. 2004.

In 2003, there were 24 minor point/group sources, and emission calculations/estimates were made for each of these sources.

The tritium emissions for 2002 totaled approximately 104 curies, which is an increase from 2002, but consistent with emissions from 1999 through 2000. The iodine-131 emission for 2003 decreased from that for 2002 to 0.06 curies. The major contributor to offsite doses at ORNL historically is argon-41, which is emitted as a nonadsorbable gas from the HFIR facility stack. However, due to a long maintenance period in 2001, cesium-138 emitted from the HFIR stack has remained the major contributor to the offsite dose since 2001. The cesium-138 emissions for 2003 were 2,810 curies (Hughes et al. 2004).

3.4.5.2 Noise

Major noise sources at ORNL and ORR include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Transportation noise sources are associated with moving vehicles that generally result in fluctuating noise levels above ambient noise levels for a short period of time. During peak hours, Bethel Valley Road traffic is a major contributor to traffic noise levels in the area. Most industrial facilities are a sufficient distance from the site boundary that noise levels at the boundary from these sources are not measurable, or are barely distinguishable from background noise levels (DOE 2000f).

Sound level measurements have been recorded at various locations within and near ORR in the process of testing sirens and preparing support documentation for the Atomic Vapor Laser Isotope Separation site. The acoustic environment along the ORR site boundary in rural areas and at nearby residences away from traffic noise is typical of a rural location, with average day-night sound levels in the range of 35 to 50 dBA. Areas within Oak Ridge are typical of a suburban area, with the average day-night sound levels in the range of 53 to 62 dBA. Traffic is the primary source of noise at the site boundary and at residences located near roads. During peak hours, plant traffic is a major contributor to traffic noise levels in the area (DOE 2000f).

The state of Tennessee has not established specific community noise standards applicable to ORNL and ORR. EPA guidelines for environmental noise protection recommend a day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974). Land use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses (14 CFR Part 150). These guidelines further indicate that noise levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures. It is expected that for most residences near ORNL, the day-night average sound level is less than 65 dBA, and is compatible with the residential land use, although for some residences along major roadways noise levels may be higher.

No distinguishing noise characteristics within ORNL have been identified. REDC and HFIR are 2.5 kilometers (1.6 miles) from the site boundary; thus, the noise levels at the site boundary from these sources are barely distinguishable from background noise levels (DOE 2000f).

3.4.6 Ecological Resources

3.4.6.1 Terrestrial Resources

Prior to Government acquisition of ORR as a security buffer for military activities, about 1,000 individual farmsteads consisting of forest, woodlots, open gazed woodlands, and fields were found on the site. Since acquisition by the Federal Government, much of the site has reverted back to a more natural state such that about 70 percent of ORR is in forest cover and about 20 percent is transitional, consisting of old fields, agricultural areas, cutover forest lands, roadsides, and utility corridors. Due to the highly diverse nature of both vegetative and animal communities on the site, portions of it have been designated as the Oak Ridge National Environmental Research Park Biosphere Reserve. Biosphere reserves are internationally recognized within the framework of the United Nations Educational, Scientific, and Cultural Organization Man and the Biosphere Program. Additionally, numerous Natural Areas and Reference Areas have been designated for the protection of rare plant and animal species and their habitat (ORNL 2002).

Plant communities at ORNL are characteristic of the intermountain regions of central and southern Appalachia; only a small fraction of ORR has been disturbed by Federal activities. The vegetation of ORR has been categorized into seven plant communities (**Figure 3–24**). Although outbreaks of southern pine beetles (*Dendroctonus frontalis*) killed over 445 hectares (1,100 acres) of pine forests in 1994 and 1999 to 2000, pine and pine-hardwood forest is the most extensive plant community on the site. Another abundant community is the oak-hickory forest, which is commonly found on ridges. Northern hardwood forest and hemlock-white pine-hardwood forest are the least common forest community types on the site. Forest resources are managed for multiple use and sustained yield of quality timber products; areas impacted by the pine beetle outbreak have been replanted or allowed to regenerate naturally. Over 1,100 vascular plants species are found on ORR (DOE 2000f, ORNL 2002).

Animal species found on ORR include 59 amphibians and reptiles, 260 birds, and 38 mammals. Animals commonly found on the site include the American toad (*Bufo americanus*), eastern garter snake (*Thamnophis sirtalis*), Carolina chickadee (*Parus carolinensis*), northern cardinal (*Cardinalis cardinalis*), white-footed mouse (*Peromyscus leucopus*), and raccoon. ORR has been designated a Tennessee Wildlife Management Area through an agreement with DOE and the Tennessee Wildlife Resources Agency. About 1,182 hectares (2,920 acres) of the Wildlife Management Area are specifically managed by the state as the Three Bends Scenic and Wildlife Management Refuge Area. The whitetail deer (*Odocoileus virginianus*) and wild turkey (*Meleagris gallopavo*) are the only species hunted onsite; however, other game animals are also present. Raptors, such as the northern harrier and great horned owl, and carnivores, such as the gray fox (*Urocyon cinereoargenteus*) and mink (*Mustela vison*), are ecologically important groups on ORR. A variety of migratory birds have been found at ORR and ORNL (DOE 2000f, ORNL 2002).

ORNL in Melton Valley contains a variety of ecosystems that range from those that are greatly disturbed to some that are relatively undisturbed. Where the valley has been heavily disturbed, the current vegetation cover is primarily grass and weeds. Vegetation of the rest of the valley is typical of forests found throughout ORR. Relatively undisturbed second-growth forests of mixed oak-hickory occur on the ridges and dry slopes, while pine and pine-hardwood on the lower slopes and valleys are typical of abandoned, eroded farmland (DOE 1996a). Vegetative communities in the vicinity of REDC and HFIR include pine, pine-hardwood forests, cedar, cedar-pine, cedar-hardwood, and oak-hickory forests (Figure 3–23) (DOE 2000f). Fauna of Melton Valley are typical of ORR and include the rat snake (*Elaphe obsolete*), black racer (*Coluber constrictor*), red-eyed vireo (*Vireo olivaceus*), scarlet tanager (*Piranga olivacea*), red-tailed hawk, red-shouldered hawk (*Buteo lineatus*), yellow-billed cuckoo (*Coccyzus americanus*), coyote, deer mouse, eastern gray squirrel (*Sciurus carolinensis*), southern flying squirrel (*Glaucomys volans*), and whitetail deer.

3.4.6.2 Wetlands

Approximately 235 hectares (580 acres) of wetlands occur on ORR, ranging in size from several square meters to about 10 hectares (25 acres) (ORNL 2002). Wetlands include emergent, scrub and shrub, and forested acres associated with bays (embayments) of the Melton Hill and Watts Bar Lake, areas bordering

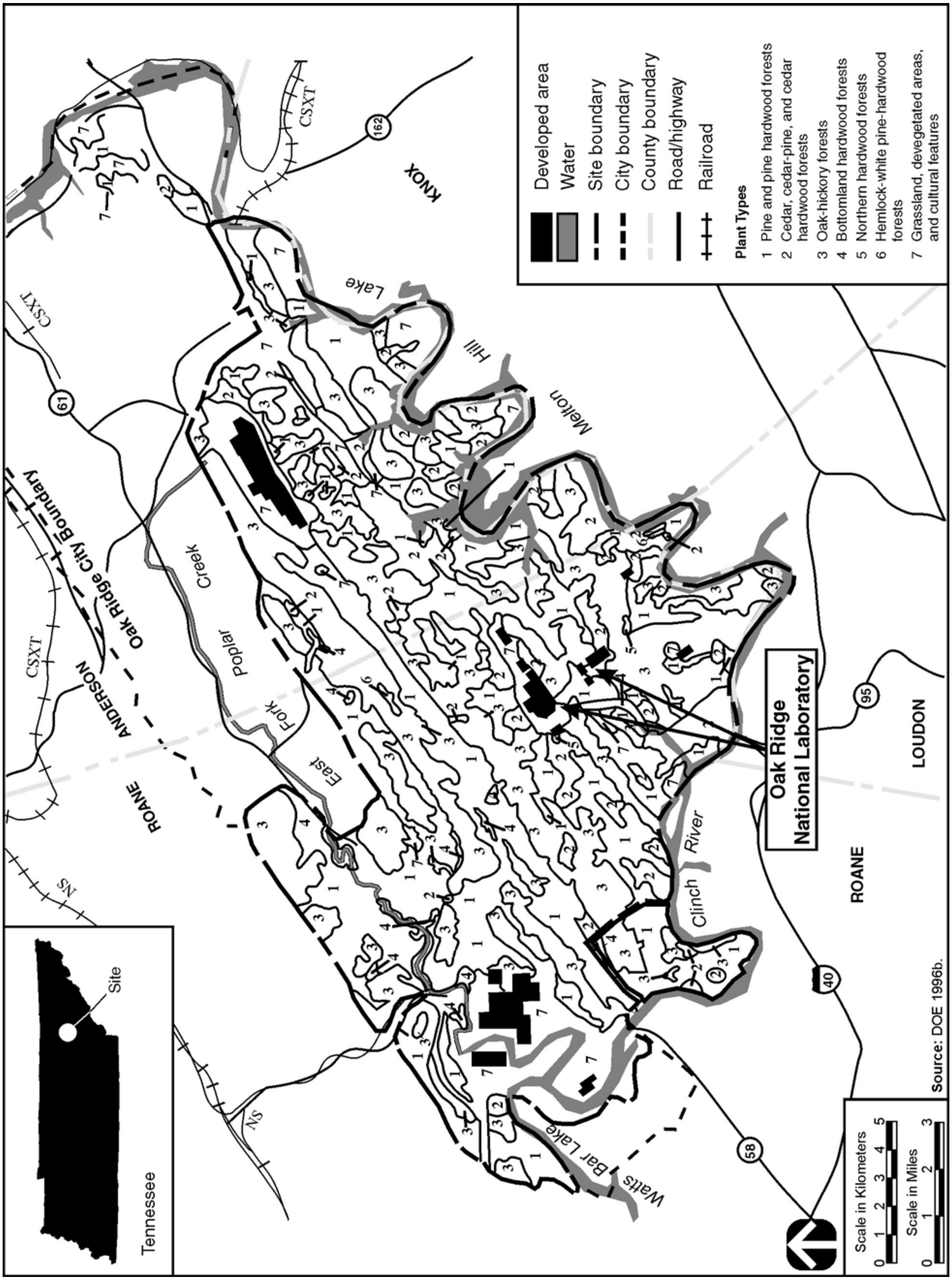

Figure 3–24 Distribution of Plant Communities at the Oak Ridge Reservation

major streams and their tributaries (riparian), old farm ponds, and groundwater seeps. Well-developed communities of emergent wetland plants in the shallow embayments of the two reservoirs typically intergrade into forested wetland plant communities, which extend upstream through riparian areas associated with streams and their tributaries. Old farm ponds on ORR vary in size and support diverse plant communities and fauna. Although most riparian wetlands on ORR are forested, areas within utility rights-of-way, such as those in Bear Creek and Melton Valley, support emergent wetland vegetation (DOE 2000f).

There are six wetlands at ORNL in the vicinity of REDC and HFIR, including one small unclassified wetland; however, none are within the developed area. These wetlands, which were identified using the criteria and methods set forth in the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987), are generally classified as palustrine forested broad-leaved deciduous wetlands, although one also includes areas of emergent vegetation. Not including the unclassified wetland, the size of these areas ranges from 0.14 hectare (0.3 acre) to 1.23 hectares (3.0 acres). Mowing routinely disturbs two of the six wetlands (DOE 2000b).

3.4.6.3 Aquatic Resources

Aquatic habitat on or adjacent to ORNL and ORR ranges from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns due to dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Aquatic areas in ORR also include seasonal and intermittent streams and old farm ponds (DOE 2000f).

Sixty-three fish species have been collected on ORR. The minnow family has the largest number of species and is numerically dominant in most streams. Fish species representative of the Clinch River in the vicinity of ORR are shad, herring, common carp (*Cyprinus carpio*), catfish, bluegill (*Lepomis macrochirus*), crappie (*Pomoxis* spp.), and freshwater drum (*Aplodinouts grunniens*). The most important fish species taken commercially in the ORR area are common carp and catfish. Commercial fishing is permitted on the Clinch River downstream from Melton Hill Dam. Area recreational species consist of crappie, largemouth bass (*Micropterus salmoides*), sauger (*Stizostedion canadense*), sunfish (*Lepomis* spp.), and catfish. Sport fishing is not permitted within ORR (DOE 2000f).

ORNL is drained by White Oak Creek. The upper portion of the creek is similar to the upper reaches of other streams originating on Chestnut Ridge. These streams typically have alternating riffle and pool habitats. The stoneroller (*Campostoma* spp.) and blacknose dace (*Rhinichethys atratulus*) are the fish species most commonly collected; 24 taxa of macroinvertebrates are present. Historically, operations at ORNL have had an adverse ecological effect on White Oak Creek. For example, the influence of ORNL is reflected in the fact that benthic macroinvertebrate populations are less diverse downstream of the site than upstream (DOE 2000f).

There are three Aquatic Reference Areas and one Reference Area in the ORNL area: Aquatic Reference Areas 3, 4, and 5, and Reference Area 28. Reference Areas are areas that are representative of the communities of the southern Appalachian region or that possess unique biotic features. Aquatic Reference Area 3, Northwest Tributary, is a second-order, frequently intermittent stream that flows along the wooded base of Haw Ridge, but with mowed fields, parking lots, and experimental ponds on the opposite bank. Aquatic Reference Area 4, First Creek, and Aquatic Reference Area 5, Fifth Creek, are first-order, spring-fed streams that flow out of Chestnut Ridge. Each area has rich benthic fauna, but is somewhat more limited with regard to the number of fish species present. Reference Area 28, Spring Pond, is a small spring-fed pond with unusually clear water for ponds on ORR; it is dominated by Nutall's waterweed (*Elodea nuttallii*) (DOE 2000f).

3.4.6.4 Threatened and Endangered Species

Forty-two federal and state-listed threatened, endangered, and other special status species have been found on ORR (**Table 3–42**); additional species that occur near the site may also be present (ORNL 2004). The gray bat (*Myotic grisencens*) (endangered) and bald eagle (threatened, but proposed to be delisted) are the only federally-listed threatened or endangered species observed on or near ORR and ORNL. The bald eagle has been seen on Melton Hill and Watts Bar Lakes. A dead gray bat was found several years ago at Y-12. The Indiana bat (endangered) has not been reported on the site (DOE 2000f). State-listed threatened or endangered species observed on ORR include 12 plant species, the peregrine falcon, and gray bat.

Table 3–42 Endangered, Threatened, and Special Status Species of the Oak Ridge Reservation

Common Name	Scientific Name	Status [a]	
		Federal	State
Plants			
American ginseng	*Panax quinquefolius*		Special Concern-CE
Appalachian bugbane	*Cimicifuga rubifolia*	Special Concern [b]	Threatened
Branching whitlow-grass	*Draba ramosissima*		Special Concern
Butternut	*Juglans cinerea*	Special Concern [b]	Threatened
Canada lily	*Lilium canadense*		Threatened
Fen orchid	*Liparis loeselii*		Endangered
Goldenseal	*Hydrastis canadensis*		Special Concern-CE
Hairy sharp-scaled sedge [c]	*Carex oxylepis var. pubescens*		Special Concern
Heavy sedge	*Carex gravida*		Special Concern
Large-tooth aspen	*Populus grandidentata*		Special Concern
Michigan lily [d]	*Lilium michiganense*		Threatened
Mountain witch-alder	*Fothergilla major*		Threatened
Northern bush-honeysuckle	*Dievilla lonicera*		Threatened
Northern white cedar	*Thuja occidentalis*		Special Concern
Nuttall's waterweed	*Elodea nuttallii*		Special Concern
Pink lady's-slipper	*Cypripedium acaule*		Endangered-CE
Pursh's wild-petunia	*Ruellia purshiana*		Special Concern
River bulrush	*Scirpus fluviatilis*		Special Concern
Shining ladies'-tresses	*Spiranthes lucida*		Threatened
Small-headed rush	*Juncus brachycephalus*		Special Concern
Spreading false-foxglove	*Aureolaria patula*	Special Concern [b]	Threatened
Tall larkspur	*Delphinium exaltatum*	Special Concern [b]	Endangered
Three-parted violet	*Viola tripartita var. tripartita*		Special Concern
Tubercled rein-orchid	*Platanthera flava var. herbiola*		Threatened
Fish			
Tennessee dace	*Phoxinus tennesseensis*		In Need of Management
Amphibians			
Four-toed salamander	*Hemidactylium scutatum*		In Need of Management
Birds			
Anhinga	*Anhinga anhinga*		In Need of Management
Bald eagle [e]	*Haliaeetus leucochphalus*	Threatened	In Need of Management
Cerulean warbler	*Dendroica cerulean*		In Need of Management
Golden-winged warbler	*Vermivora chrysophtea*		In Need of Management
Great egret	*Casmerodius alba*		In Need of Management
Little blue heron	*Egretta caerulea*		In Need of Management
Loggerhead shrike	*Lanius ludovicianus*		In Need of Management

Common Name	Scientific Name	Status [a]	
		Federal	State
Northern harrier	*Circus cyaneus*		In Need of Management
Olive-sided flycatcher	*Contopus borealis*		In Need of Management
Peregrine falcon	*Falco peregrinus*		Endangered
Sharp-shinned hawk	*Accipiter striatus*		In Need of Management
Snowy egret	*Egretta thula*		In Need of Management
Yellow-bellied sapsucker	*Sphyrapicus varius*		In Need of Management
Mammals			
Gray bat	*Myotic grisenscens*	Endangered	Endangered
Southeastern shrew	*Sorex longirostris*		In Need of Management

[a] Status: CE = Status due to commercial exploitation.
[b] Special Concern was listed under the formerly used Federal C2 candidate designation. More information needed to determine status.
[c] Has not been relocated during recent surveys.
[d] Believed to have been extirpated from ORR by the impoundment at Melton Hill.
[e] Proposed for delisting.
Source: ORNL 2004.

No federally-listed endangered or threatened species (or critical habitat) are known to regularly occur in Melton Valley in the vicinity of ORNL. However, the bald eagle (federally-threatened) and the peregrine falcon (state endangered) are uncommon visitors to the vicinity. While some State-listed endangered or threatened species of wildlife may occasionally visit the vicinity, no suitable breeding habitat is present, and no such animal species are known to regularly occur there. Of species listed by the state as in need of management, the southeastern shrew (*Sorex longirostris*), sharp-shinned hawk (*Accipiter striatus*), and the yellow-bellied sapsucker (*Sphyrapicus varius*) are known to be present in Melton Valley. Other animal species listed by the state as in need of management that may be found in wetlands in Melton Valley are the northern harrier, the little blue heron (*Egretta caerulea*), the great egret, and the snowy egret (*Egretta thula*) (DOE 1996a).

Some state-listed plants are known to occur in Melton Valley. The Pink lady's slipper (*Cypripedium acaule*) (state endangered) and ginseng (special concern) grow in the valley. A small population of Canada lily (*Lilium canadense*) (state threatened) is also found in the area. River bulrush (*Scirpus fluviatilis*) (state special concern) has also been reported from Melton Valley (DOE 1996a).

No threatened, endangered, or sensitive plant or animal species have been recorded at or in the vicinity of REDC and HFIR. Further, there is no potential habitat for such species confirmed in close proximity to the area (DOE 2000f).

3.4.7 Cultural Resources

3.4.7.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written record. More than 20 cultural resources surveys have been conducted at ORR. About 90 percent of ORR has received at least some preliminary walkover or archival-level study, but less than 5 percent has been intensively surveyed. Most cultural resource studies have occurred along the Clinch River and adjacent tributaries. Prehistoric sites recorded at ORR include villages, potential burial mounds, camps, quarries, a chipping station, limited activity locations, and shell scatters. More than 45 prehistoric sites have been recorded at ORR to date. At least 13 prehistoric sites are considered potentially eligible for the National Registry of Historic Places, but most of these sites have not yet been evaluated. Additional prehistoric sites may be anticipated in the unsurveyed portions of ORR. In 1994, a Programmatic Agreement concerning the management of historic and cultural properties at ORR was executed among the DOE Oak Ridge Operations Office, the Tennessee State Historic Preservation Officer, and the Advisory Council on Historic Preservation. This agreement was executed to satisfy DOE's responsibilities regarding Sections 106 and 110 of the National Historic Preservation Act, and resulted in DOE preparing a *Cultural Resources Management Plan* for ORR. No prehistoric properties have been located within or immediately adjacent to ORNL's REDC and HFIR (DOE 2000f).

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age. Paleontological remains consist of fossils and their associated geological information. The majority of geological units with surface exposures at ORR contain paleontological materials. Paleontological materials consist primarily of invertebrate remains, and these have relatively low research potential. Paleontological resources at ORNL would not be expected to differ from those found elsewhere on ORR.

3.4.7.2 Historic Resources

Several historic resource surveys have been conducted at ORR. Historic resources identified at ORR include both archaeological remains and standing structures. Documented log, wood frame, or fieldstone structures include cabins, barns, churches, gravehouses, springhouses, storage sheds, smokehouses, log cribs, privies, henhouses, and garages. Archaeological remains consist primarily of foundations, roads, and trash scatters. A total of 32 cemeteries are located within the present boundaries of ORR. More than 240 historic resources have been recorded at ORR, and 38 of those sites may be considered potentially eligible for listing on the National Registry of Historic Places. Freel's Cabin and two church structures, George Jones Memorial Baptist Church and the New Bethel Baptist Church, are listed on the National Registry. These structures date from before the establishment of the Manhattan Project. National Registry sites associated with the Manhattan Project include the Graphite Reactor at ORNL, listed on the National Registry of Historic Places as a National Historic Landmark, and three traffic checkpoints, Bear Creek Road, Bethel Valley Road, and Oak Ridge Turnpike Checking Stations. Many other buildings and facilities at ORR are associated with the Manhattan Project and are eligible for the National Registry. Historic building surveys have been completed for ORNL (DOE 2000f).

A survey was conducted in 1993 to identify properties at ORNL that are included or are eligible for inclusion in the National Register of Historic Places. Eligible properties include the ORNL Historic District in the ORNL East Support Area, the Molten Salt Reactor Experiment Facility, (previously known as the Aircraft Reactor Experiment Building), the Tower Shielding Facility, and White Oak Lake and Dam. Of these structures, the Molten Salt Reactor Experiment Facility is the closest eligible property to REDC and HFIR. It is located about 0.4 kilometers (0.25 miles) to the north (DOE 2000f).

3.4.7.3 Traditional Cultural Properties

Resources that may be sensitive to American Indian groups include remains of prehistoric and historic villages, ceremonial lodges, cemeteries, burials, and traditional plant gathering areas. Apart from prehistoric archaeological sites, to date no American Indian resources have been identified at ORR. No American Indian sacred sites or cultural items have been found within or immediately adjacent to REDC and HFIR (DOE 2000f).

3.4.8 Socioeconomics

Statistics for employment, the regional economy, population, housing, and local transportation are presented for the region of influence, a 4-county area in which 87.7 percent of all ORR employees reside (**Table 3–43**). In 2003, ORR employed 12,856 persons.

Table 3–43 Distribution of Employees by Place of Residence in the Oak Ridge Reservation Region of Influence, 2003

County	Number of Employees	Total Site Employment (percent)
Anderson	3,539	27.5
Knox	4,834	37.6
Loudon	684	5.3
Roane	2,215	17.2
Region of influence total	11,272	87.7

Source: DOE 2004e.

3.4.8.1 Regional Economic Characteristics

Between 2000 and 2003, the civilian labor force in the region of influence increased by 5.7 percent to the 2003 level of 296,890. In 2003, the unemployment rate in the ORR region of influence (4.4 percent) was slightly lower than the state of Tennessee unemployment rate of 5.8 percent (TN DOL and WD 2005).

In 2003, the trade, utilities, and transportation sector represented the largest portion (21 percent) of the socioeconomic region of influence labor force, followed by Government (15.3 percent), and professional and business services (15 percent). The totals for these employment sectors in Tennessee were 22.1 percent, 15.1 percent, and 11.1 percent, respectively (TN DOL and WD 2005).

3.4.8.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population and income information is included in **Table 3–44**. Of the 4 counties in the region of influence, Loudon County grew by the largest percentage (20 percent) over the last decade from 1990 to 2000. Anderson County experienced the smallest growth over the same period (4.3 percent). Persons self-designated as minority individuals comprise 10.0 percent of the total region of influence population. This minority population is composed largely of Black or African American residents (6.9 percent). People who self-designated as Hispanic represent 1.3 percent of the total region of influence population.

Income information for the ORR region of influence is included in **Table 3–45**. Loudon County has the highest median household income of the 4 counties in the region of influence ($40,401) and the lowest percent of persons (10.0 percent) living below the poverty line. Roane County has the lowest median household income ($33,226) and the largest number of individuals (13.9 percent) living below the poverty line. The average median household income in the four counties is comparable to the median household income of the state of Tennessee ($36,360) during this same time period.

3.4.8.3 Housing

Table 3–46 lists the total number of occupied housing units and vacancy rates in the region of influence. In 2000, of the total 244,536 housing units in the region of influence, 92 percent were occupied and 8 percent were vacant. Roane County had the greatest vacancy rate of the 4 counties at 9 percent and Loudoun County had the smallest vacancy rate at 8 percent. Home values were the most expensive in Knox County, with a median housing value of $98,500, and the least expensive in Roane County at $86,500.

Table 3–44 Demographic Profile of the Population in the Oak Ridge Reservation Region of Influence

	Anderson	*Knox*	*Loudon*	*Roane*	*Region of Influence*
Population					
2000 population	71,330	382,032	39,086	51,910	544,358
1990 population	68,250	335,749	31,255	47,227	482,481
Percent change from 1990 to 2000	+4.3	+12.1	+20.0	+9.0	+11.4
Race (2000) (percent of total population)					
White	93.4	88.1	95.9	95.2	90.0
Black or African American	3.9	8.6	1.1	2.7	6.9
American Indian and Alaska Native	0.3	0.3	0.3	0.2	0.3
Asian	0.8	1.3	0.2	0.4	1.1
Native Hawaiian & Other Pacific Islander	0.0	0.0	0.0	0.0	0.0
Some other race	0.4	0.5	1.4	0.2	0.5
Two or more races	1.2	1.2	1.0	1.2	1.2
Percent minority	6.6	11.9	4.1	4.8	10.0
Ethnicity (2000)					
Hispanic or Latino	787	4,803	894	359	6,843
Percent of total population	1.1	1.3	2.3	0.7	1.3

Source: DOC 2005.

Table 3–45 Income Information for the Oak Ridge Reservation Region of Influence

	Anderson	*Knox*	*Loudon*	*Roane*	*Tennessee*
Median household income 2000 (dollars)	35,483	37,454	40,401	33,226	36,360
Percent of persons below poverty line (2000)	13.1	12.6	10.0	13.9	13.5

Source: DOC 2005.

Table 3–46 Housing in the Oak Ridge Reservation Region of Influence

	Anderson	*Knox*	*Loudon*	*Roane*	*Region of Influence*
Housing (2000)					
Total units	32,451	171,439	17,277	23,369	244,536
Occupied housing units	29,780	157,872	15,944	21,200	224,796
Vacant units	2,671	13,567	1,333	2,169	19,740
Vacancy rate (percent)	8.2	7.9	7.7	9.3	8.1
Median value (dollars)	87,500	98,500	97,300	86,500	Not available

Source: DOC 2005.

3.4.8.4 Local Transportation

Vehicles access ORR via 3 State Routes. State Route 95 forms an interchange with Interstate 40 and enters the reservation from the south. State Route 58 enters the reservation from the west and passes just south of the ETTP. State Route 162 extends from Interstate 75 and Interstate 40 just west of Knoxville, and provides eastern access to ORR (Figure 3–20).

Within ORR, several routes are used to transfer traffic from the state routes to the main plant areas. Bear Creek Road, north of Y-12, flows in an east-west direction and connects Scarboro Road on the east end of the plant with State Road 95 and State Road 58. Bear Creek Road has restricted access around Y-12, and is not a public thoroughfare. Bethel Valley Road, a public roadway, provides access to ORNL, and extends from the east end of ORR at State Road 62 to the west end at State Route 95. Access to the REDC and HFIR is provided by secondary roads with controlled access: First Street, which runs north-south from Bethel Valley Road, and Melton Valley Road, which runs east-west and passes the entry road (DOE 2000f).

Two main branches provide rail service for ORR. The CSX Transportation line at Elza (just east of Oak Ridge) serves Y-12 and the Office of Science and Technological Information in east Oak Ridge. The Norfolk Southern main line from Blair provides easy access to the ETTP. The Clinch River has a barge facility located on the west end of ORR near the ETTP that is occasionally used to receive shipments that are too large or too heavy to be transported by rail or truck. McGhee Tyson Airport, 37 kilometers (23 miles) from ORR, is the nearest airport serving the region, with major carriers providing passenger and cargo service. A private airport, Atomic Airport, Inc., is the closest air transportation facility to Oak Ridge. Oak Ridge has a part-time public transportation system (DOE 2000f).

3.4.9 Human Health Risk

3.4.9.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of ORNL are shown in **Table 3–47**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to ORNL and ORR operations.

Table 3–47 Sources of Radiation Exposure to Individuals in the Oak Ridge National Laboratory Vicinity Unrelated to Oak Ridge National Laboratory and Oak Ridge Reservation Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural background radiation [a]	
Cosmic radiation	36
External terrestrial radiation	51
Internal terrestrial radiation	39
Radon in homes (inhaled)	200
Other background radiation [b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	Less than 1
Air travel	1
Consumer and industrial products	10
Total	390

[a] DOE 2000f.
[b] NCRP 1987.
Note: Value of radon is an average for the United States.

Releases of radionuclides to the environment from ORR operations provide another source of radiation exposure to individuals in the vicinity of ORNL. Types and quantities of radionuclides released from ORR during normal operations in 2003 are listed in the *Oak Ridge Reservation Annual Site Environmental Report* for 2003 (Hughes et al. 2004). The doses to the public resulting from these releases are presented in **Table 3–48**. These doses fall within radiological limits per DOE Order 5400.5, and are much lower than those of background radiation.

Table 3–48 Radiation Doses to the Public from Oak Ridge Reservation Normal Operations in 2003 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed individual (millirem)	10	0.24	4	2 [b]	100	2.24 [c]
Population within 80 kilometers (50 miles) (person-rem) [d]	None	10.8	None	20	100	30.8
Average individual within 80 kilometers (50 miles) (millirem) [e]	None	0.01	None	0.02	None	0.03

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem-per-year limit from airborne emissions is required by the Clean Air Act, and the 4-millirem-per-year limit is required by the Safe Drinking Water Act. For this EIS, the 4-millirem-per-year value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR Part 834, as published in 58 FR 16268. If the potential total dose exceeds the 100-person-rem value, it is required that the contractor operating the facility notify DOE.
[b] These doses are mainly from drinking water (approximately 0.35 millirem) and eating fish from the Clinch River section of Poplar Creek.
[c] This total dose includes a conservative value of 1 millirem per year from direct radiation exposure to a cesium field near the Clinch River.
[d] Based on a population of about 1,040,041 in 2003.
[e] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.
Source: Hughes et al. 2004.

Using a risk estimator of 6.0×10^{-4} LCF per rem (Appendix C of this EIS), the risk of an LCF to the maximally exposed member of the public due to radiological releases from ORR operations in 2003 is estimated to be 1.34×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of ORR operations is approximately one in 746,000, as it takes several to many years from the time of radiation exposure for a cancer to manifest itself.

According to the same risk estimator, 1.74×10^{-5} excess LCFs are projected in the population living within 80 kilometers (50 miles) of ORR from normal operations in 2003. To place this number in perspective, it may be compared with the number of cancer fatalities expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of cancer fatalities expected during 2003 from all causes in the population living within 80 kilometers (50 miles) of ORR would be 2,080, which is much higher than the LCFs estimated from ORR operations in 2003.

ORR workers receive the same doses as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at ORR from operations in 2003 are presented in **Table 3–49**. These doses fall within the radiological regulatory limits of 10 CFR Part 835. According to a risk estimator 6.0×10^{-4} LCF per person-rem among workers (Appendix C of this EIS), the number of projected LCFs among ORR workers from normal operations in 2003 is 0.07.

Table 3–49 Radiation Doses to Workers from Oak Ridge National Laboratory Normal Operations in 2003 (total effective dose equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Average radiation worker (millirem)	None [b]	48.5
Total workers (person-rem) [c]	None	116

[a] The radiological limit for an individual worker is 5,000 millirem per year. However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. It has therefore established the Administrative Control Level of 2,000 millirem per year; the site must make reasonable attempts to maintain individual worker doses below this level.
[b] No standard is specified for an "average radiation worker," however, the maximum dose that this worker may receive is limited to that given in footnote "a."
[c] Based on a worker population of 2,389 with measurable doses in 2003.
Source: DOE 2003e.

A more detailed presentation on the radiation environment, including background exposures and radiological releases and doses, is presented in the *Oak Ridge Reservation Annual Site Environmental Report for 2003* (Hughes et al. 2004). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and offsite) are also presented in the report.

3.4.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and other adverse health effects.

Carcinogenic Effects—Health effects in this case are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen. This could be incremental or excess individual lifetime cancer risk.

Noncarcinogenic Effects—Health effects in this case are determined by the ratio between the calculated or measured concentration of the chemical in the air and the reference concentration or dose. This ratio is known as the Hazard Quotient. Hazard Quotients for noncarcinogens are summed to obtain the Hazard Index. If the Hazard Index is less than 1, no adverse health effects would be expected.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emissions and NPDES permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur by inhaling air containing hazardous chemicals released to the atmosphere during normal ORNL operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those via the inhalation pathway.

Baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed from normal operations at ORNL. These concentrations are in compliance with applicable guidelines and regulations. Information on estimating the health impacts of hazardous chemicals is presented in Appendix C of this EIS.

Exposure pathways to ORNL workers during normal operations could include inhaling contaminants in the workplace atmosphere and through direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a meaningful estimate of impacts. However, workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. ORNL workers are also protected by adherence to Occupational Safety and Health Administration and EPA standards that limit the workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals used in the operational processes ensure that these standards are not exceeded. Additionally, DOE requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm.

3.4.9.3 Health Effects Studies

Two epidemiologic studies were conducted to determine whether ORR and ORNL contributed to any excess cancers in communities surrounding the facility. One study found no excess cancer mortality in the population living in counties surrounding ORR and ORNL, when compared to the control populations in other nearby counties and elsewhere in the United States. The other study found slight excess cancer incidences of several types in the counties near ORR and ORNL, but less than the number of expected cancers incidences for other types of cancers. Excess cancer mortalities have been reported and linked to specific job categories, age, and length of employment, as well as to the levels of exposure to radiation (DOE 2000f).

A pilot study on mercury contamination conducted by the Tennessee Department of Health and Environment showed no difference in urine or hair mercury levels between individuals with potentially high mercury exposures compared to those with little potential for exposure. However, soil analysis showed that the mercury in soil is inorganic, which decreases the likelihood of a toxic accumulation in living tissue (bioaccumulation) and adverse health effects. Studies are continuing on the long-term effects of exposure to mercury and other hazardous chemicals.

For a more detailed description of the epidemiologic studies, refer to Appendix M.4.6 of the *Storage and Disposition PEIS* (DOE 1996d).

3.4.9.4 Accident History

There have been no safety-related accidents causing significant injury or harm to workers, or posing any sort of harm to the offsite public, at HFIR or REDC during their operational lifetimes (DOE 2000f).

In addition, there have been no accidents with a measurable impact on offsite population during nearly 50 years of Y-12 operations at ORR. The most noteworthy accident in Y-12's history was a 1958 criticality accident, which resulted in temporary radiation sickness for a few ORR employees. In 1989, there was a one-time accidental release of xylene into the ORR sewer system with no offsite impacts. Accidental releases of anhydrous hydrogen fluoride occurred in 1986, 1988, and 1992, with little onsite and negligible offsite impact. The hydrogen fluoride system where these accidents occurred is being modified to reduce the probability of future releases and to minimize the potential consequences if a release should occur.

3.4.9.5 Emergency Preparedness and Security

Each DOE site has established an emergency management program that would be activated in the event of an incident that threatens the health and safety of workers and the public. This program has been developed and maintained to ensure adequate response to most incident conditions and to provide response efforts for incidents not specifically considered. The emergency management program includes emergency planning, preparedness, and response.

DOE has overall responsibility for emergency planning and operations at ORR. However, DOE has delegated primary authority for event response to the operating contractor. Although the contractor's primary response responsibility is onsite, the contractor does provide offsite assistance, if requested, under the terms of existing mutual aid agreements. If a hazardous materials event with offsite impacts occurs at a DOE facility, elected officials and local governments are responsible for the State's response efforts. The Tennessee Emergency Management Agency is the established agency responsible for coordinating State emergency services. When a hazardous materials event occurring at DOE facilities is beyond the capability of local government and assistance is requested, the Tennessee Emergency Management Agency Director may direct State agencies to provide assistance to the local governments. To accomplish this task and ensure prompt initiation of emergency response actions, the Director may cause the state Emergency Operations Center and Field Coordination Center to be activated. City or county officials may activate local Emergency Operations Centers in accordance with existing emergency plans.

DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at the Hanford Site in May 1997.

3.4.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. As discussed in Appendix B of this EIS, minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income. In the case of ORNL, the potentially affected area includes parts of Tennessee, North Carolina, and Kentucky.

Figure 3–25 shows ORNL, REDC, HFIR, and the region of potential radiological impact. As shown in the figure, areas potentially at radiological risk from the current missions performed at HFIR and REDC include the cities of Knoxville, Oak Ridge, and Sarboro in eastern Tennessee. Thirty counties are included or partially included in the potentially affected area, including 25 counties in Tennessee (see **Figure 3–26**): Anderson, Bledsoe, Blount, Bradley, Campbell, Claiborne, Cumberland, Fentress, Grainger, Jefferson, Knox, Loudon, McMinn, Meigs, Monroe, Morgan, Overton, Pickett, Polk, Putnam, Rhea, Roane, Scott, Sevier, and Union. The remaining five counties, partially included in the potentially affected area, include two counties in Kentucky and three counties in North Carolina: McCreary and Whitley, and Cherokee, Graham and Swain, respectively. **Table 3–50** provides the total minority composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, approximately 7.3 percent of the county residents identified themselves as members of a minority group. Black or African American and Hispanics comprised more than 68 percent of the minority population. The percentage of minority populations residing in the States of Tennessee, North Carolina, and Kentucky were 20.8 percent, 29.8 percent, and 10.7 percent, respectively.

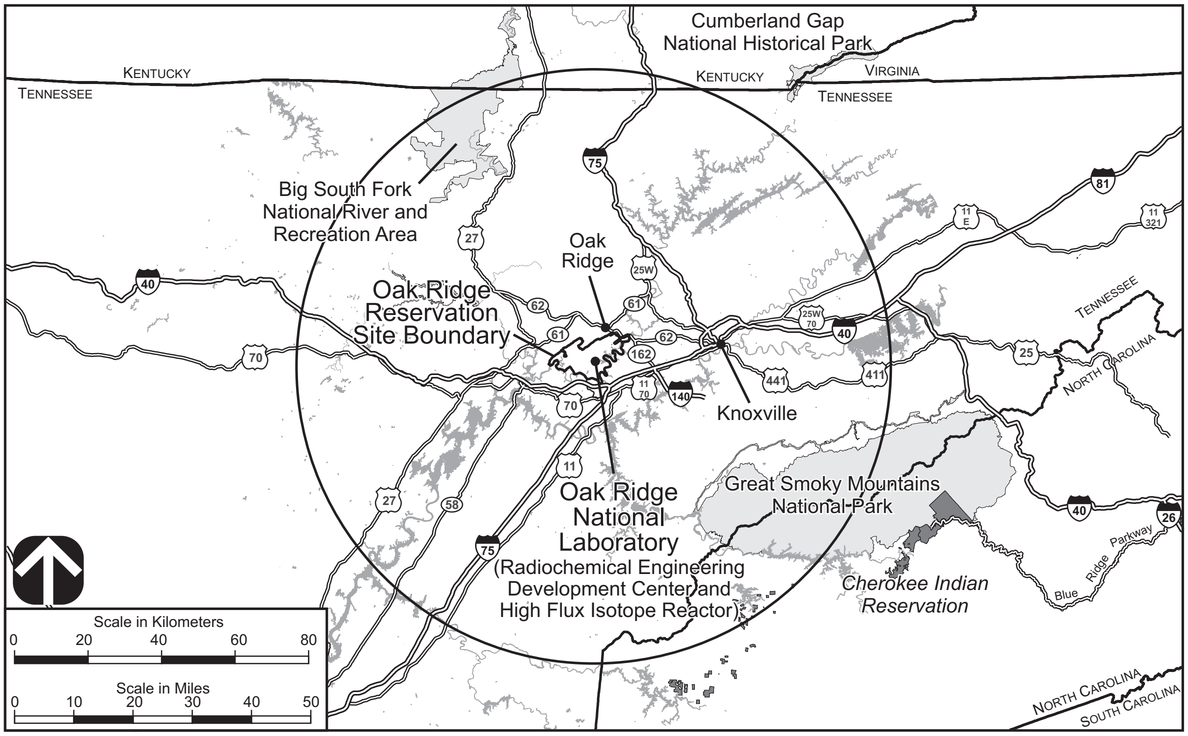

Figure 3–25 Location of Oak Ridge National Laboratory and Indian Reservation Surrounding Oak Ridge Reservation

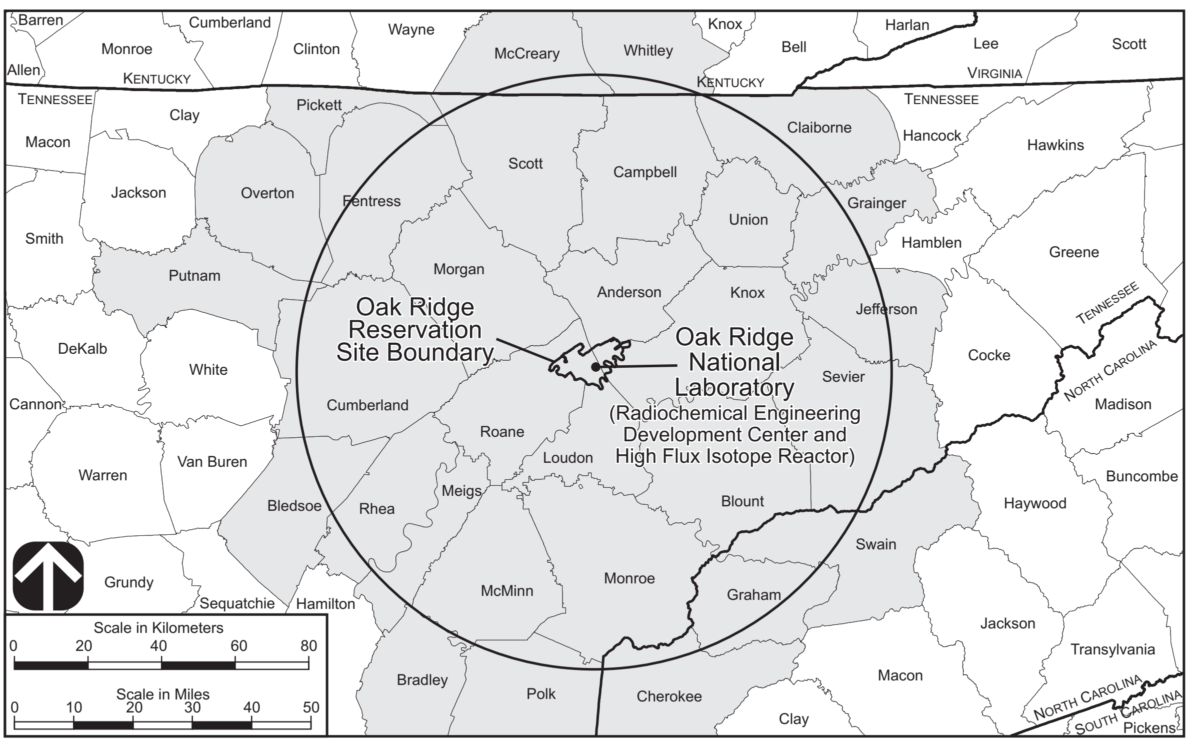

Figure 3–26 Potentially Affected Counties Near Oak Ridge National Laboratory

Table 3–50 Populations in Potentially Affected Counties Surrounding Oak Ridge National Laboratory in 2000

Population Group	*Population*	*Percentage of Total*
Minority	102,482	7.3
Hispanic	17,198	1.2
Black or African American	52,396	3.7
American Indian and Alaska Native	8,060	0.6
Asian	8,639	0.6
Native Hawaiian and Pacific Islander	172	0.0
Two or more races	15,216	1.1
Some other race	801	0.1
White	1,305,083	92.7
Total	1,407,565	100.0

Source: DOC 2005.

The percentage of population for whom poverty status was determined in potentially affected counties in 2000 was approximately 16.2 percent. In 2000, nearly 13.5 percent of the total population of Tennessee reported incomes less than the poverty threshold. The percent of population for whom poverty status was determined reporting incomes below the poverty threshold in Kentucky and North Carolina were 15.8 percent and 12.3 percent, respectively. In terms of percentages in 2000, minority populations in the 30 potentially impacted counties were lower than either of the Kentucky, North Carolina, and Tennessee State percentages, while low-income resident populations in potentially impacted counties were higher than the state percentages.

3.4.11 Waste Management and Pollution Prevention

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all Federal and state statutes and DOE Orders. Disposal and management of previously generated ORR waste, known as legacy waste, is the responsibility of DOE’s environmental management contractor, which is working to repackage, remove, and dispose of the existing legacy waste and newly generated wastes. The strategy is to dispose of current inventories of all waste types and close many of the existing storage facilities. The long-range strategy is to rely on a combination of onsite and offsite facilities to dispose of newly generated waste.

3.4.11.1 Waste Inventories and Activities

ORR manages the following types of waste: transuranic, mixed transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Waste generation rates and the inventory of stored waste from activities at ORR are provided in **Table 3–51**. Waste generation rates specifically for HFIR and REDC activities are provided in **Table 3–52**. ORR waste management capabilities are summarized in **Table 3–53**. More detailed descriptions of the waste management system capabilities at ORR are included in the *Storage and Disposition PEIS* (DOE 1996d).

Table 3–51 2003 Waste Generation Rates and Inventories at Oak Ridge Reservation and Oak Ridge National Laboratory

Waste Type	*Generation Rates (cubic meters per year)*		*Inventory (cubic meters)*	
	ORR [a]	*ORNL*	*ORR* [a]	*ORNL*
Transuranic	3	3	2,450	2,450
Low-level radioactive	2,028	64	20,000 [b]	5,214
Mixed low-level radioactive [c]	154	1	26,000	3,000
Hazardous	36,000 kilograms per year	20,000 kilograms per year	1,689	–
Nonhazardous				
Liquid	269,000	60,600	Not applicable [d]	Not applicable [d]
Solid	3,661 metric tons per year	1,039 metric tons per year	Not applicable [d]	Not applicable [d]

ORR = Oak Ridge Reservation, ORNL = Oak Ridge National Laboratory.
[a] Represents entire waste generated or managed at ORR, including ORNL.
[b] Excludes waste from DOE environmental restoration activities.
[c] Mixed liquid low-level radioactive waste is reported as low-level radioactive waste. Certain contents are mixed-permit-by-rule.
[d] Generally, this waste is not held in long-term storage.
Note: To convert from cubic meters to cubic yards, multiply by 1.308. To convert from kilograms to pounds, multiply by 2.2. To convert from metric tons to kilograms multiply by 1,000.
Source: DOE 2004d, 2000f.

Table 3–52 Waste Generation Rates at the Radiochemical Engineering Development Center and High Flux Isotope Reactor

Waste Type	*REDC (cubic meters per year)*	*HFIR (cubic meters per year)*
Transuranic		
Contact-handled	16	0
Remotely handled	9	0
Low-level radioactive		
Liquid	52	0
Solid	65	48
Process waste	0	19,700
Mixed low-level radioactive	less than 1	0
Hazardous	13,200 kilograms	0
Nonhazardous		
Liquid	96,700	138,200
Sanitary wastewater	3,130	7,310
Solid	294	0

REDC = Radiochemcial Engineering Development Center, HFIR = High Flux Isotope Reactor.
Note: To convert from cubic meters to cubic yards, multiply by 1.308. To convert from kilograms to pounds, multiply by 2.2.
Source: DOE 2000f.

Table 3–53 Waste Management Capabilities at Oak Ridge Reservation

Facility Name/ Description	*Capacity*	*Status*	*Applicable Waste Type*					
			TRU	*Mixed TRU*	*LLW*	*Mixed LLW*	*Haz*	*Non-Haz*
Y-12: Treatment Facility (cubic meters per year except as otherwise specified)								
West End Treatment Facility (Building 9616-7)	10,221	Online			X	X	X	X
Central Pollution Control Facility	10,200	Online			X	X	X	
Acid Neutralization and Recovery Facility (Building 9818)	2,100	Online				X		
Uranium Chip Oxidizer Facility	Classified	Online			X			
Cyanide Treatment Facility	185	Online				X	X	
Plating Rinsewater Treatment Facility (Building 9623)	30,283	Online					X	X
Steam Plant Wastewater Facility	177,914	Online					X	X
Oak Ridge Sewage Treatment Plant (offsite) (cubic meters per day)	5,300	Online						X
Baler Facility (Building 9720-25)	41,700	Online						X
Waste Coolant Processing Facility (Building 9983-78)	1,363	Online			X	X		
Organic Handling Unit (Building 9815) (gallons per day)	500	Online			X	X		
Uranium Recovery Operations (Building 9212)	2,100	Online				X		
Y-12: Storage Facility (cubic meters)								
Aboveground Storage Pads (Buildings 9830-2 through 7)	7,130	Online			X			
Container Storage Areas (Buildings 9206 and 9212)	30	Online			X	X		
Container Storage Facility (Building 9720-12)	123	Online			X	X		
Contaminated Scrap Metal Storage Yard	4,740	Online			X			X
Cyanide Treatment Facility (Building 9201-5N)	8	Online				X	X	
Liquid Organic Waste Storage Facility (Building 9720-45, OD-10)	198	Online				X	X	
Liquid Storage Facility (Building 9416-35)	416	Online				X	X	
PCB and RCRA Hazardous Drum Storage Facility (Building 9720-9)	1,404	Online				X	X	
RCRA and PCB Container Storage Area (Building 9720-58)	1,130	Online				X	X	
RCRA Staging and Storage Facility (Building 9720-31)	170	Online				X	X	
RCRA Storage Facility (Building 9811-1, OD-8)	723	Online			X	X	X	
Waste Oil/Solvent Storage Facility (Building 9811-8, OD-9)	790	Online			X	X	X	

Facility Name/ Description	Capacity	Status	Applicable Waste Type					
			TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Tank Farm (Building 9212)	151	Planned				X		
Container Storage Area/Production Waste Storage Facility (Building 9720-32)	2,335	Online					X	
Low Level Waste Storage Pad (Building 9720-44)	Not specified	Online			X			
Classified Waste (Container) Storage Area (Building 9720-59)	1,090	Online			X	X		
Organic Handling Unit (Building 9815)	8	Online					X	
Depleted Uranium Storage Vaults I and II (Building 9825-1 and 2 oxide vaults and Building 9809)	1,020	Online			X			
West Tank Farm	10,600	Online			X	X		
Y-12: Disposal Facility (cubic meters)								
Industrial and Sanitary Landfill V [a]	1,100,000 [a]	Online						X
Construction Demolition Landfill VI [a]	119,000 [a]	Online						X
ORNL: Treatment Facility (cubic meters per year)								
Process Waste Treatment Plant	280,000	Online			X			
Melton Valley Low-Level Waste Immobilization Facility and Liquid Low-Level Waste Evaporation Facility	110,000	Online			X			
Waste Compaction Facility (Building 7831)	11,300	Online			X			
Sanitary Waste Water Treatment Facility (design capacity)	414,000	Online						X
Nonradiological Wastewater Treatment Facility	1,510,000	Online					X	
ORNL: Storage Facility (cubic meters)								
Buildings 7826, 7834, 7842, 7878, 7879, and 7934	1,760	Online	X	X				
Bunker and Earthen Trenches (Solid Waste Storage Area 5N Building 7855 and Solid Waste Storage Area 7 Building 7883)	1085	Online	X		X			
Liquid Low-Level Radioactive Waste Systems	3,230	Online			X			
Onsite tanks	7,850	Online			X			
Buildings 7507W, 7654, 7823, and Tank 7830a	393	Online Tank 7830a (standby)				X		
Hazardous Waste Storage Facility (Buildings 7507 and 7652 and Buildings 7651 and 7653)	130	Online					X	
Interim Waste Management Facility	5,365 (1,730) [b]	Online			X			

Facility Name/ Description	Capacity	Status	Applicable Waste Type					
			TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
ORNL: Disposal Facility (cubic meters)								
Shared Landfills V and VI	(a)	Online						X
TRU Waste Treatment Facility (low-temperature drying) (five year capacity)	4,050	Planned	X	X	X	X		
ETTP: Treatment Facility (cubic meters per year)								
TSCA Incinerator (Building K-1435)	15,700	Online			X	X		
Central Neutralization Facility (permitted operating capacity)	221,000	Online				X		
Sewage Treatment Plant (Building K-1203)	829,000	Online						X
ETTP: Storage Facility (cubic meters)								
Building K-25, outside areas, K-1313 A and K-33	44,000	Online			X			
Current permitted container (solids/sludges/liquid wastes) and tank (liquids) storage capacity	97,000	Online				X		
Total current permitted waste pile unit storage capacity	120,000	Online				X		
Stockpiled at scrap yard	Not specified	Online						X
ETTP: Disposal Facility (cubic meters)								
Shared Landfills V and VI	(a)	Online						X

TRU = transuranic, LLW = low-level waste; HAZ = hazardous; PCB = polychlorinated biphenyl; RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act; ETTP = East Tennessee Technology Park.
[a] Industrial and Sanitary Landfill V and Construction Demolition Landfill VI serve all three sites for disposal of solid nonhazardous waste. Their disposal capacities are 1,100,000 cubic meters and 119,000 cubic meters, respectively.
[b] Available as of June 1999.
Note: To convert from cubic meters to cubic yards, multiply by 1.308.
Source: DOE 2000f.

3.4.11.2 Transuranic Waste

Although ORNL is the only current generator of transuranic waste, other sites at ORR have produced small quantities of transuranic waste in the past and are likely to do so again during decontamination and decommissioning activities. Transuranic waste includes contact-handled transuranic and remotely handled transuranic. Normally, contact-handled transuranic waste consists primarily of miscellaneous waste from glovebox operations (e.g., paper, glassware, plastic, shoe covers, and wipes), discarded HEPA filters, and discarded equipment (e.g., gloveboxes and processing equipment). Contact-handled transuranic waste has a surface dose rate that does not exceed 200 millirem per hour. Generally, contact-handled transuranic waste is contained within polyethylene bags inside 208-liter (55-gallon) stainless steel drums. Metal paint cans, plastic buckets, and other similar containers are also used to package waste inside the drums.

Remotely handled transuranic wastes are usually contained in concrete casks (1.4 meters [4.5 feet] in diameter by 2.3 meters [7.5 feet] high). The wall thicknesses of the casks are currently either 15 centimeters (6 inches) or 30.5 centimeters (12 inches) thick, depending on the radiation level of the contents. A large polyethylene bag is placed inside the cask for additional contamination control prior to use. Most remotely handled transuranic wastes inside the concrete casks are also contained inside polyethylene bags. Smaller waste packages such as 11-liter (2.9-gallon) plastic buckets, 3.7-liter (0.98-gallon) paint cans, and 18.9-liter (5.0-gallon) metal cans are packaged within the polyethylene bags. Fiber drums and carbon and steel drums have also been used to package waste inside the concrete casks. Intermediate-sized items that will not fit in the previously mentioned packages are generally placed in vinyl bags, then placed inside the lined waste casks. Large cask items may be placed directly in the casks.

As of January 1999, approximately 1,000 cubic meters (1,310 cubic yards) of contact-handled transuranic waste was in retrievable drum storage in the Bunker and Earthen Trenches. The amount of remotely handled transuranic waste was about 550 cubic meters (719 cubic yards) (64 FR 4079). Current activities center around certification of contact-handled waste, designing of a repackaging and certification facility for remote-handled wastes, and planning for shipment of transuranic waste to WIPP.

3.4.11.3 Low-Level Radioactive Waste

Solid low-level radioactive waste is compactible radioactive waste such as paper, plastic, cloth, glass, cardboard, filters, floor sweepings, styrofoam, clothing, ceiling tile, and miscellaneous radioactively contaminated trash. The waste may include up to 20 percent lightweight or non-smeltable metal items. The solid low-level radioactive waste normally generated at ORNL consists primarily of radioactively contaminated personnel protection equipment, paper debris, trapping media, and process equipment. The Interim Waste Management Facility at ORNL only accepts low-level radioactive waste generated at ORNL. However, the Interim Waste Management Facility is at two-thirds of capacity, and access to this facility for the proposed RPS nuclear production activities is not expected. Solid low-level radioactive waste is also being stored at the ETTP and Y-12 for future disposal. Contaminated scrap metal is stored above ground at the Scrap Metal Facility, the old salvage yard at Y-12, and at ORNL which is being managed by the DOE scrap metal program until further disposal methods are evaluated.

The basic low-level radioactive waste strategy is to:

1. Use the Interim Waste Management Facility for legacy waste until it is filled to capacity.

2. Stage low-level radioactive waste at all sites, with emphasis on storage at the ETTP until a disposal site is available.

3. Ship waste to the NTS, the Hanford Site, or a commercial disposal site as access is approved, and according to site-specific waste acceptance criteria.

3.4.11.4 Mixed Low-Level Radioactive Waste

RCRA mixed low-level radioactive waste is in storage at Y-12, ETTP, and ORNL. Because prolonged storage of these wastes exceeded the 1-year limit imposed by RCRA, ORR entered into a Federal Facility Compliance Agreement for RCRA Land Disposal Restriction wastes with EPA on June 12, 1992. This agreement was terminated with the issuance of the TDEC Commissioner's Order, effective October 1, 1995, which requires DOE to comply with the *Site Treatment Plan* prepared by ORR. The plan contains milestones and target dates for DOE to characterize and treat its inventory of mixed wastes at ORR. Sludges contaminated with low-level radioactivity are generated by settling and scrubbing operations, and in the past were stored in ponds at the ETTP.

Sludges have been removed from these ponds and a portion has been fixed in concrete at the Sludge Treatment Facility. The concreted sludges are being shipped offsite for disposal. The raw sludges are stored, pending further treatment.

The primary facility generator of liquid mixed waste is the Toxic Substances Control Act Incinerator from the wet scrubber blowdown. This waste is currently being treated at the Central Neutralization Facility, which provides pH adjustment and chemical precipitation. Treated effluents are discharged through an NPDES outfall. The contaminated sludges are stored as mixed waste at the ETTP.

The ETTP Toxic Substances Control Act Incinerator has a design capacity to incinerate 909 kilograms (2,000 pounds) per hour of mixed liquid waste and up to 455 kilograms (1,000 pounds) per hour of solids and sludge (91 kilograms [200 pounds] per hour maximum sludge content). The Toxic Substances Control Act Incinerator is capable of incineration of both Toxic Substances Control Act- and RCRA-mixed wastes. The Toxic Substances Control Act Incinerator capacity utilization for incinerable solids is limited to ORR wastes to support the completion of enforceable milestones required by the ORR *Site Treatment Plan*. Because of permit limits (Toxic Substances Control Act, RCRA, state of Tennessee), the incinerator is not running at full capacity.

The major type of mixed waste generated at ORNL is mixed waste oils. Mixed waste oils are generated when oils are removed from systems that have operated in radiation environments. Radiation levels in these oils are typically low (less than or equal to 10 millirem per hour). Generally, these wastes consist of vacuum pump oil, axle oil, refrigeration oil, mineral oil, or oil/water mixtures. The principal components of scintillation fluids are toluene and/or xylene, culture medium, and miscellaneous organics. Other mixed wastes generated at ORNL include organic wastes, carcinogenic wastes, mercury-contaminated solid waste, waste solvents, corrosives, poisons, and other process waste. Because of the diversity of the mixed waste generated at ORNL, quantities are usually small.

Radioactive wastes contaminated with polychlorinated biphenyl are being stored because of lack of treatment and disposal capacities. DOE and EPA signed a Federal Facility Compliance Agreement, effective December 16, 1996, to bring ETTP into compliance with Toxic Substances Control Act regulations for use, storage, and disposal of polychlorinated biphenyls. It also addressed the approximately 10,000 pieces of nonradioactive polychlorinated biphenyls-containing dielectric equipment used in the shutdown of diffusion plant operations.

3.4.11.5 Hazardous Waste

RCRA-regulated wastes are generated by ORR and ORNL in laboratory research, electroplating operations, painting operations, descaling, demineralizer regeneration, and photographic processes. Certain other wastes (e.g., spent photographic processing solutions) are processed onsite into a nonhazardous state. Those wastes that are safe to transport, and have been certified as having no radioactivity added, are shipped offsite to RCRA-permitted commercial treatment and disposal facilities. Small amounts of reactive chemical explosives that would be dangerous to transport offsite, such as aged picric acid, are processed onsite in the Chemical Detonation Facility at ORNL.

3.4.11.6 Nonhazardous Waste

Nonhazardous wastes are generated from numerous ORR and ORNL activities. For example, the steam plant produces nonhazardous sludge. Scrap metals are discarded from maintenance and renovation activities and are recycled when appropriate. Construction and demolition projects produce nonhazardous industrial wastes. Other nonhazardous wastes include paper, plastic, glass, can, cafeteria wastes, and general trash. All nonradioactive medical wastes are autoclaved to render them noninfectious and are sent to the Y-12 Sanitary Landfill. Remedial action projects also produce wastes requiring proper management. The state of Tennessee permitted landfill (Construction Demolition Landfill VI) receives nonhazardous industrial materials such as fly ash and construction debris. Asbestos and general refuse are managed in Industrial and Sanitary Landfill V located at Y-12.

3.4.11.7 Waste Minimization

The DOE Oak Ridge Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at ORR. This is accomplished by eliminating waste through source reduction or material substitution; recycling potential waste materials that cannot be minimized or eliminated; and treating waste generated to reduce its volume, toxicity, or mobility prior to storage or disposal. Implementing pollution prevention projects reduced the amount of waste generated at ORR in 1998 by approximately 64,900 cubic meters (84,000 cubic yards). Examples of pollution prevention projects completed in 1998 at the Oak Ridge Operations Office include reducing cleanup/stabilization of low-level radioactive waste by approximately 395 cubic meters (517 cubic yards), mixed low-level radioactive waste by approximately 119 cubic meters (156 cubic yards), and hazardous waste by approximately 83 metric tons (91 tons) by providing incentives in contracts for projects to turn over vacant and decontaminated buildings to the Oak Ridge Operations Office; reducing routine operations mixed low-level radioactive waste by approximately 693 cubic meters (906 cubic yards) by selling various scrap metals (including clean and contaminated carbon steel and copper) to an outside vendor for cleaning and recycling; and reducing transuranic waste generation by less than 1 cubic meter (1.3 cubic yards) per year by replacing three oil-lubricated vacuum pumps with dry pumps, which eliminated the transuranic-contaminated waste oil stream and associated waste (DOE 2000f).

3.4.11.8 *Waste Management PEIS* Records of Decision

Waste Management PEIS RODs affecting ORR and ORNL are shown in **Table 3–54** for the waste types analyzed in this *Consolidation EIS*. Decisions on the various waste types are being announced in a series of RODs that have been issued under the *Waste Management PEIS*. The initial transuranic waste ROD was issued on January 20, 1998 (63 FR 3629) with several subsequent amendments; the hazardous waste ROD was issued on August 5, 1998 (63 FR 41810); the high-level radioactive waste ROD was issued on August 12, 1999 (64 FR 46661); and the low-level radioactive waste and mixed low-level radioactive waste ROD was issued on February 18, 2000 (65 FR 10061). The transuranic waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare transuranic waste for disposal at WIPP. Each DOE site that has or will generate transuranic waste will, as needed, prepare and store its transuranic waste onsite until the waste is shipped to WIPP. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own nonwastewater hazardous waste onsite in existing facilities, where this is economically favorable. The high-level radioactive waste ROD states that immobilized high-level radioactive waste will be stored at the site of generation until transfer to a geologic repository. The low-level radioactive waste and mixed low-level radioactive waste ROD states that for the management of low-level radioactive waste, minimal treatment will be performed at all sites and disposal will continue, to the extent practicable, onsite at INL, LANL, ORR, and SRS. In addition, the Hanford Site and NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at the Hanford Site, INL, ORR, and SRS and disposed of at the Hanford Site and NTS. More detailed information concerning DOE's preferred alternatives for the future configuration of waste management facilities at ORR is presented in the *Waste Management PEIS* and the high-level radioactive waste, transuranic waste, hazardous waste, and low-level radioactive and mixed low-level radioactive waste RODs.

Table 3–54 *Waste Management PEIS* Records of Decision Affecting Oak Ridge Reservation and Oak Ridge National Laboratory

Waste Type	***Preferred Action***
High-level radioactive	ORR does not currently manage high-level radioactive waste. [a]
Transuranic and mixed transuranic	DOE has decided that ORR should prepare and store its transuranic waste onsite pending disposal at WIPP [b].
Low-level radioactive	DOE has decided to treat ORR liquid low-level radioactive waste onsite. [c] Separate from the *Waste Management PEIS*, DOE prefers offsite management of ORR solid low-level radioactive waste after temporary onsite storage.
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at ORR. [c] This includes the onsite treatment of ORR waste and could include treatment of some mixed low-level radioactive waste generated at other sites.
Hazardous	DOE has decided to use commercial and onsite ORR facilities for treatment of ORR nonwastewater hazardous waste. DOE will also continue to use onsite facilities for wastewater hazardous waste. [d]

[a] From the ROD for high-level radioactive waste (64 FR 46661).
[b] From the ROD for transuranic waste (63 FR 3629).
[c] From the ROD for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[d] From the ROD for hazardous waste (63 FR 41810).
Sources: DOE 2000f, 63 FR 3629, 63 FR 41810, 64 FR 46661, 65 FR 10061.

3.4.12 Environmental Restoration Program

DOE is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at ORR and ORNL. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

On November 21, 1989, EPA placed ORR on the National Priorities List, which identifies sites for possible long-term remedial action under CERCLA. DOE, EPA Region IV, and the TDEC completed a Federal Facility Agreement, effective January 1, 1992. This agreement coordinates ORR inactive site assessment and remedial actions. Portions of the Federal Facility Agreement are applicable to operating waste management systems. Existing actions are conducted under RCRA and applicable State laws that minimize duplication, expedite response actions, and achieve a comprehensive remediation of the site. More information on regulatory requirements for waste disposal is provided in Chapter 5 of this EIS.